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China Report

SCIENCE AND TECHNOLOGY

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CHINA REPORT

SCIENCE AND TECHNOLOGY

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PEOPLE'S REPUBLIC OF CHINA

NATIONAL DEVELOPMENTS

ABSTRACTS

NATIONAL DEVELOPMENTS

OFFICIAL INTERVIEWED ON TECHNICAL MARKETS

Beijing JINGJI RIBAO in Chinese 27 Dec 84 pp 1, 2

[Interview with a leading cadre of the State Scientific and Technological Commission, by JINGJI RIBAO reporter: "Technical Markets Are the Key to The Reform of the Scientific and Technological System"; on 26 December 1984]

[Text] On 26 December, a leading cadre of the State Scientific and Technological Commission answered our reporter's questions on technical markets and the commercialization of technology.

Question: Why is technology a commodity? What role does it play in promoting production and expediting technological development?

Answer: As the socialist commodity economy develops and the division of labor in society becomes more and more elaborate, mental labor and technical progress play an increasingly important role in production, becoming the key in productivity development. Mental labor has come to account for an increasing portion of the value of a material commodity and has been gradually detached from the material commodity to assume a separate existence of its own as an intellectual product (i.e., technical achievements) in the realm of social production.

According to the Marxist labor theory of value, both mental and physical labor create value and both contribute to the material wealth of human society in the form of material goods or intellectual products. Technical achievements are the crystallization of the creative and complex labor of scientific and technical workers. As a special kind of product, they usually take the form of arts and handicrafts, techniques or some unique skills...etc. Because of the rapid growth of production and the spectacular progress science and technology has made, intellectual products have become a greater asset than material products in the development of social production. They are essential to developing productive forces, improving labor productivity and creating social material wealth. We have gradually come to realize this point.

As a commodity in China's socialist commodity economy, technology, like other commodities, also has the properties of a commodity, namely its use and value. Its value is demonstrated only through circulation and exchange of commodities. As a special kind of commodity, technology has been gaining increasing recognition and attention and is now the most valuable of commodities. The economic

competition in the world today actually boils down to a match between the technologies of different nations. Facts show that whoever owns more and the most advanced technologies would also have a fast-growing economy, a high labor productivity and abundant material wealth.

Question: What is the significance of developing technical markets? What are their functions?

Answer: Following development of the commodity economy, adoption of new technologies and developing new products has become an urgent necessity to increase productivity and achieve technical progress. A new special market--the technical market--has emerged to satisfy this need. An important component of the socialist unified market, the technical market has demonstrated its great vitality from the very beginning and will be instrumental in stimulating China's technological progress and economic revitalization.

From the pure circulation and exchange of technical achievements, the technical market has developed into a diverse market which includes technical consultancy, technical contracting, technology transfer, technical demonstration, technical services, technical training, circulation of information, integration of technology and trade, integration of technology and production, marketing of new products, open bidding to solve a particular problem and the recruitment of expertise. The circulation and exchange of technology takes multifarious forms and involves provinces, ministries, small, medium and large cities and rural areas. They involve the entire people and collectives as well as individuals. They can be limited to a region or trade as well as inter-regional and inter-trade.

The technical market has obvious benefits for economic development and scientific and technical progress, which can be summed up as follows:

1. It promotes and mobilizes the enthusiasm and creativeness of scientific research units and personnel to come up with more and better achievements faster.

2. It shortens the time that we take to convert a technical achievement into productive forces.

3. It creates a positive social climate in which knowledge and experts are respected. When technical achievements demonstrate their value as a commodity, society would come to appreciate the learning of scientific and technical personnel.

4. It encourages scientific research units and researchers to reorient their research towards society and the market and integrate it closely with production so that it can serve production, be regulated by market needs and prosper together with the national economy. In the process, it can also solve the problem of deciding what scientific research units and their personnel should and should not do.

5. It breaks down the barriers that have long existed between departments and regions and facilitates the socializing of scientific and technical work. The

development of the technical market brings together research institutions, colleges and universities, military industries, mines and factories, rural and small town enterprises, and the technical achievements of the entire people, collectives and individuals, and integrates them with urban and rural economic construction.

6. It rewards the diligent, penalizes the indolent and encourages the applicability of technical achievements. The technical market provides an arena where the value of technical achievements and the contributions of scientific and technical workers are made plain for all to see.

7. It promotes the rational mobility of intellectuals and experts. Experts should not be assessed on the basis of diplomas and formal qualifications alone. Opportunities should also be provided for self-educated professionals to contribute to the four modernizations.

Question: How should we determine the ownership of profits from technology transfer? What are the principles we should follow in negotiating the rates of technology or technological achievement?

Answer: A technical achievement belongs to the person who has invested the materials and labor which have made the achievement possible. Broadly speaking, there are right now the following kinds of ownership:

1. Research achievements financed by state appropriations are the properties of the state. Where a patent has been applied for and granted, the case will be handled in accordance with the "Patent Law." As long as it does not violate the relevant regulations, a research unit is allowed to transfer an achievement in return for a payment which normally could be retained by the unit.

2. When an achievement results from a project commissioned and financed by an enterprise, its ownership normally resides with the enterprise. With the permission of the enterprise, however, the unit responsible for its development can transfer its possession. Income derived therefrom will be split between the enterprise and the unit in accordance within a fixed period of time all go to the research unit.

3. Achievements which arise in the course of the research work of a scientific research unit belong to the unit.

Concerning the three types of ownership mentioned above, research units can set aside a certain portion of the income derived from a transfer of possession as awards for the personnel directly involved in research and development, the greater the contribution, the larger the award. The actual distribution of this sum of money is the responsibility of the project leader.

4. On condition that they have fulfilled their share of planned tasks, scientific research personnel of a unit or a project group can contract with a production unit to provide technical services, technical consultancy and technical development, in accordance with the needs of the production unit. The scientific research unit concerned should actively encourage and support

such activities. The ownership of research achievements and the distribution of their benefits can be worked out by joint consultation, taking into consideration the amount of assistance offered by the research unit.

5. Provided he has accomplished the assignments of his regular job, a scientific research worker is free to undertake in his spare time projects which meet social needs, e.g., technical development, technical consultancy and services. His unit should be supportive of such activities. Achievements and income derived therefrom belong to the worker. Should he need to use the equipment and facilities of his unit in the course of such research, the unit should accommodate him and charge him a fee to be determined at its discretion.

On negotiated rates for technical achievements:

It is more complex to negotiate the rate of a technical achievement than that of an ordinary commodity. Instead of simply resorting to the old formula of adding a certain amount of profit to costs, we should consider the economic results created by the application of an achievement to production. As with other commodities, the price of a technical achievement is subject to the regulating mechanism of the market. At present, it is not advisable to put a ceiling on the prices of such achievements. We should let the technical market warm up by leaving the buyer and seller to negotiate their own prices in accordance with the principle of mutual benefit.

Question: Since the appearance of the technical market, what are the problems which you think we should pay attention to? How should we handle them?

Answer: A very good momentum has appeared in the commercialization of technological achievements and the development of the technological market. This is the way things are going and we should affirm and support it. But some people are worried that mistakes could occur. They have two major concerns.

1. There is the fear that by emphasizing the commercialization of technology, we are encouraging the masses of scientific and technical workers to cater to the needs of the technical market by flocking to short-term projects which yield quick results, to the neglect of key national projects and long- and medium-term research tasks.

In my opinion, socialist construction precisely needs short-term projects which yield quick results and produce real economic benefits. As for key national projects and long- and medium-range projects, they will be carried out under the state's mandatory and guidance plans. The state will improve its management system, use economic means to arouse the enthusiasm of scientists and technicians for research, and ensure that state's key construction projects are completed on time.

2. Another fear is that research workers' spare-time research activities might interfere with the performance of their regular duties.

First, there is the clear stipulation that scientific research workers can moonlight only if they pledge to fulfill their normal duties at work. At the same time, all research units must improve their management systems to give full rein to the initiative of their staff.

We must realize that if scientific research personnel devote their spare time to serving socialist construction, it can only be to the good. The state will benefit and so will the people. We should support their work. It is only right that they be rewarded for their hard work. There is nothing wrong with that. There may be cases in which scientific workers' off-hours earnings are excessive. In these cases, they should be required to pay income taxes in accordance with relevant regulations.

Question: What is the situation in China's technical market today?

Answer: Since the third plenary session of the 11th Central Committee, as China began to reform its rural and urban economy and scientific and technological system and develop a commodity economy, our technical market has also picked up momentum. Following the establishment of the Shenyang Technical Service Company in 1980 and the first National Technical Exchange and Trade Symposium in Wuhan in 1981, national technical market service organizations have sprung up like mushrooms in a variety of forms and at all levels. Up to last August, there were already over 1,000 scientific and technical development and exchange centers and technical service companies above the municipal level. A nationwide coordinating network has also been created. Cities such as Tianjin, Beijing and Wuhan have set up permanent technical markets. According to statistics released by eight technical development and exchange organizations in Beijing, Wuhan, Shenyang, Dalian, Zhongqing, Hangzhou, Xian and Chengdu, 34 large-scale scientific and technical exchange fairs have been held since 1981, featuring a total of 19,000 scientific achievements and services. At these fairs, 5,300 contracts on technical transfers and technical cooperation were signed and the total volume of business conducted amounted to 130 million yuan. Over one million people took part to engage in exchange transactions and negotiations. In addition, the technical markets have organized 123 scientific research-production complexes and concluded 9,320 scientific research agreements with a total value of 160 million yuan, contributing two billion yuan to the state in output value and enriching the coffers of the treasury by 320 million yuan in profits taxes. Moreover, they have organized 512 technical training classes which provided training for 42,000 people.

Question: What should we do in the days ahead to advance the development of China's technical markets?

Answer: In developing the technical markets, we are basically following the principle that "economic construction must rely on science and technology; science and technology must be geared towards economic construction." It is a task for scientific commissions and leading scientific and technical departments at all levels. As this is a big job, we must make sure we do it well. In accordance with the spirit of State Council instructions, the State Scientific and Technological Commission and the State Economic Commission should take a leading part in this mission. The National Defense Scientific, Technological and Industrial Commission, etc., should be involved as a coordinator to propel its development.

Question: What is the relationship between the reform of our scientific and technological system and the development of the technical market?

Answer: We need to reform the scientific and technological system in order to integrate science and technology with economic construction and mobilize the enthusiasm of the masses of scientific and technical personnel for the four modernizations. The development of the technical market is a key to all our efforts to reform the scientific and technological system. This reform must revolve around the development of technology as a commodity and the technical market.

12581
CSO: 4008/215

NATIONAL DEVELOPMENTS

XINHUA REVIEWS SCIENCE FUND COMMITTEE PROJECTS

OW051200 Beijing XINHUA in English 1138 GMT 5 Mar 85

[Text] Beijing, March 5 (Xinhua) -- The science fund committee of the Chinese Academy of Sciences has financed more than 2,700 research projects since it was founded in 1982.

Endowed with a grant of 120 million yuan, the projects were selected from 4,770 applications from 28 provinces, municipalities and autonomous regions and 35 central government departments.

Over 5,000 specialists took part in assessing the applications, a committee official said, adding that 79.4 percent of the grants went to universities and colleges.

About 98 percent of the 1,000 projects financed in 1982 and 1983 had been completed or nearly so, the official said. Scientists working on these projects finished more than 2,800 academic papers, 854 of them published in Chinese and foreign journals or read at international symposiums. Sixty approved findings are being applied to production.

A new method to recover carbon dioxide from waste gas, developed by professor Shi Yajun from the East China Chemical Engineering Institute, is increasing returns in chemical works, fertilizer plants and iron and steel mills.

Professor Yuan Runzhang at the Wuhan Building Materials Engineering Institute invented a new process for obtaining activated coal ash. The process has helped thermal power plants make full use of their discharged coal ash.

A solid acid catalyst for synthesizing glycol and ether products, developed by professor Li Hexuan at Nankai University in Tianjin, has reduced the consumption of raw materials by 21 percent, saving 1,400 yuan (about 490 U.S. dollars) per ton.

8108
CSO: 4010/104

NATIONAL DEVELOPMENTS

SHANGHAI SCIENTIFIC MANAGEMENT REFORMS PAY OFF

OW071407 Beijing XINHUA in English 1300 GMT 7 Mar 85

[Text] Shanghai, March 7 (Xinhua) -- Shanghai's scientific and technological management reforms have profited research institutions and stimulated application of the latest findings.

The municipal science and technology commission says the city completed 1,585 research projects last year, more than double the preceding year, applying 834, over 52 percent, in production.

Reforms include:

-- charging for transfer of technology;
-- fixed-sum research contracts with the state;
-- joint research-production schemes;
-- personnel "banks";
-- new technical markets; and
-- more international cooperation.

These performance-linked incentives, says the commission, have minimized state investment.

The Textile Research Institute last year fulfilled all contracts on one-third of its state grant.

A trading network now promotes application of findings. The technology development center's six technology fairs last year produced nearly 1,000 agreements, worth in all over 20 million yuan (about seven million U.S. dollars).

Nearly 800 research institutions and 45 colleges set up 2,022 research-production partnerships, which the commission sees as the quickest way to convert research into products.

The Shanghai Micro-Organism Research Institute entered into long-term cooperation with 50 citric acid plants across the country, providing five generations of strains which brought profits to 20 loss-making plants.

This ended China's import of 2,000 tons of citric acid annually. It now exports 20,000 tons a year.

A joint dye and size project set up by the Textile Research Institute and the Guangming Chemical Plant made a profit of 950,000 yuan (about 331,000 U.S. dollars) last year, compared to some 100,000 yuan (about 35,000 U.S. dollars) in 1981.

Last year also saw cooperation with Japan, Federal Germany and the United States in new medicines and solar technology.

8318

CSO: 4010/104

NATIONAL DEVELOPMENTS

SHENYANG TECHNICAL FAIR PROMOTES DEVELOPMENT

OW080015 Beijing XINHUA in English 1517 GMT 7 Mar 85

[Text] Shenyang, March 7 (Xinhua) -- The annual technical fair held in Shenyang city for the past five years has promoted production, improved scientific management and helped the development of rural industrial enterprises chiefly through the encouragement of technical transfer, local authorities said.

Shenyang, capital of Liaoning province in Northeast China, pioneered technical transfer through the market in 1980 . The practice is now endorsed by the Chinese central government.

Previously, there was no recognized go-between for technical transfer in China, and many research findings lay fallow; this practise tended to dampen research initiative.

More than 11,000 technical transfer contracts have been concluded at the city's technical fairs in the past five years. Surveys made by the city authorities show that in this period some 1,500 items of transferred technology have yielded more than 700 million yuan of profits.

Technical transfer has diversified research schemes and sources of funds for research institutes. The annual turnover at the technical fair comes to 35 million yuan on the average. The fair also helps research institutes to select projects according to demand and earn money from their research findings.

The paper said the technical fair has encouraged research institutes to develop their capacities and provide competitive technology. Some contracted projects have become research topics for post-graduates in Shenyang's Northeast Engineering Institute.

Technical transfer has also promoted rural industrial enterprises to develop 225 new products and complete 535 technical renovation projects. With upgraded products, 65 local enterprises have been made profitable.

8332
CSO: 4010/104

NATIONAL DEVELOPMENTS

CHINA HOLDS TALKS WITH U.S. COMPUTER FIRM

HK170352 Beijing CHINA DAILY in English 17 Mar 85 p 2

[Article by staff reporter Zhu Ling]

[Text] Burroughs Corporation, one of the leading U.S. computer manufacturers, is pressing to expand business ties with China, including joint production of advanced model computers.

The American firm is currently discussing with Huafeng Industrial Corporation of China the possibility of launching joint ventures to produce large-scale computers. Burroughs officials said they stand ready to cooperate with Huafeng in developing software for a banking information network, said Zhang Zhenlin, Huafeng's general manager.

The offer coincides with an effort by China's electronics industry to import new technology to improve the quality of domestically manufactured computers.

Zhang also said that a service center for Burroughs' products will soon be established in Beijing to provide training for clients in operation and maintenance. A warehouse to stock Burroughs' spare parts valued at $500,000 will also be constructed.

Currently, there are more than 30 Burroughs' customers in China.

Business relations between Burroughs and Huafeng have been progressing fruitfully over the past 4 years. A new milestone was reached on Wednesday when a large computer network system imported from Burroughs last year went into operation at Huafeng's computer center. It is China's largest imported computer system and signifies a new step forward in transfer of advanced technology from the U.S. to China, said Wang Zhengzhong, the center's deputy director.

The system includes a computer capable of 2.5 million operations per second with a main memory function of six megabytes. The main computer is connected to four small computers, six small branch systems and 34 microcomputers located elsewhere in the capital.

The system allows direct links between all its users so that they can share information stored anywhere in the network.

The computer is programmed to assist scientific research, design work, business management, data collection and information sharing systems.

Last December, Burroughs signed a contract with an electronics equipment factory in Yunnan Province for joint manufacture of microcomputers. Under the contract, 4,500 microcomputers will be produced in 2 years, said David Chien, account manager of Burroughs Asia Ltd.

China produced more than 20,000 microcomputers in 1984 for use in more than 10,000 civil projects.

According to an earlier report in CHINA DAILY, the Ministry of Electronics Industry has announced its intention to eventually establish a nationwide computer network. More extensive use of micro-processors must be considered a vital step in the country's technological revolution, the ministry said.

It also said that the electronics industry has become one of the fastest-growing sectors in China's economy. China's electronics industry did 24 billion yuan worth of business in 1984, netting a profit of 10.8 billion yuan. The ministry plans to make the electronics industry an 80 billion yuan business by the turn of the century, tripling last year's figures.

CSO: 4010/106

NATIONAL DEVELOPMENTS

XINHUA: PRC ATTENDS BELGIUM TECHNOLOGICAL FAIR

OW261636 Beijing XINHUA in English 1544 GMT 26 Feb 85

[Text] Brussels, February 25 (Xinhua) -- The 1985 Flamande International Technological Fair opened today in Gand, Belgium, with the participation of more than 700 enterprises from 22 countries.

The fair, covering an area of 43,000 square meters, put on exhibit many kinds of the most modern technology, such as micro-electronics, genetic engineering, new materials, astronavigation, and robots.

Gaston Geens, president of the Flamande district, presided over the opening ceremony which was attended by king of the Belgians Baudouin, Belgian prime minister Wilfried Martens, Luxembourg prime minister Jacques Santer, president of the commission of the European community Jacques Delors and foreign diplomats in Belgium.

Wang Guangying, vice-chairman of the All-China Federation of Industry and Commerce, was also present on the occasion.

The fair is scheduled to last until March 3.

8141
CSO: 4010/101

GANSU INCREASES AUTONOMY OF SCIENTIFIC, TECHNOLOGICAL UNITS

Beijing GUANGMING RIBAO in Chinese 5 Nov 84 p 1

[Article by Gu Yonggao [7357 3057 7559]: "Gansu Province Increases the Autonomy of Scientific and Technological Units"]

[Text] The Gansu provincial party committee and provincial government recently decided to increase the autonomy of scientific and technological units and do away with outmoded rules and regulations that hampered the initiative of scientific and technical personnel. Thereby enabling the reform of the science and technology system and economic system to develop simultaneously.

The major contents of Gansu Province's reform in scientific and technological work include:

The implementation of an appointment system or selection system for the directors of scientific research academies (institutes) with the term of office ranging from 3 to 5 years. The directors of scientific research academies (institutes) have the right to determine the equipment and facilities of the organization, to appoint and remove cadres and to contract out scientific and technological projects, technical services, or to choose tasks themselves. They have the right to hire scientists and technologists and to dismiss or refuse personnel who are not suitable for their work. They have the right to set up funds and decide how to distribute them. They have the right to promote and reward scientists and technicians for remarkable contributions.

Practice state, collective and individual science and technology simultaneously. Scientists and technicians on the job can, on approval, resign or keep their job without pay. Diversify technological development, popularization and services. The income taxes of these businesses can be decreased or exempted at the beginning. Concerned departments should protect their legal benefits and should not discriminate against them, tax them illegally or extort benefits from them.

Scientific research design, education, production units, etc. can organize various forms of trans-professional, trans-departmental and trans-regional integrated bodies for scientific research production. They can practice different kinds of integrated bodies with their customers home and abroad

and enjoy loans on favorable terms for the funds they need. Their income taxes can be reduced or exempted for a short term as a special favor.

Scientific and technological units engaged in technological development, popularization and application should change their operation-expense-paid system with a paid contract system within 3 to 5 years and gradually come to depend mainly on technological income for a self-sufficient economy. Research units engaged in basic studies and partially applied studies should change their system of allocating operation expenses based on the number of people. They should try to practice task contracting and bidding system and, in the form of foundation system, allocate funds to the best contractors for the task.

Practice the task and technical contract responsibility system. Task groups can be organized on a voluntary basis. Tasks can be contracted collectively or individually. Practice compensated service for technical contracts: those with economic benefits can be paid according to the percentages provided in the contract; those without economic benefits but with social benefits can be paid in accordance with the difficulty of the technology and the scale of contribution; agricultural technological contracts can adopt the compensation forms of retention of percentages for integrated production, fixed compensation for fixed production, and payment on the basis of efficiency and quality.

Practice compensated transfer for all scientific and technical results. Offer loans on favorable terms for reconstruction projects and provide space, labor, funds and energy for imported technology. New products, on the examination and approval of concerned departments, can be exempt from taxation for 1 to 2 years. For those scientific and technological tasks not called for in the plan, the institutions in Gansu subordinate to the central government will be compensated favorably.

Colleges and universities, scientific research design and large-scale business and enterprises with a large concentration of scientists and technicians should assign organizations, assign staff members and direction. The proportion of various personnel and positions should be definite. Any extra personnel should be sent outside. Scientists and technicians who do not use what they have learned or whose work does not suit their talent or who for some reason cannot bring their talent into play at the unit they work should be allowed to move to other units which suit them. If there is anybody who tries to make things difficult for these scientists and technicians, the personnel department of the organization should make the transfer directly. Scientists and technicians can also resign. Units which employ scientists and technicians from cities to work in prefectures, counties, towns and villages can pay them a certain amount for allowances.

12369
CSO: 4008/116

NATIONAL DEVELOPMENTS

GUANGDONG PROMOTES TECHNOLOGY EXPORT MARKETS

HK151342 Guangzhou NANFANG RIBAO in Chinese 14 Mar 85 p 1

[Report by Xu Jindan [6079 6855 0030]: "Our Province Energetically Develops Export Markets for its Technology"]

[Text] In recent years, Guangdong has made use of the advantages of being adjacent to Hong Kong and Macao and having wide overseas connections to actively promote technology exports. While introducing large quantities of advanced technology and equipment from abroad, this province has begun to push its advanced and new technologies into international markets. Last year, Guangdong had 107 new technology and new products items exhibited at the China export commodity fair and had 25 items sold to foreign customers, with the transactions reaching a value of $190,000. At present, this province has established relations with more than 200 institutions of higher learning, research units, academic organizations, and business companies in more than 20 countries and regions.

This province has mainly adopted the following forms to develop overseas markets for technology: First, carrying out cooperation in research and in developing new technologies and products with institutions in Hong Kong, Macao, and other countries; second, jointly running various technological training courses; third, holding exhibitions of advanced foreign technologies; fourth, sending technical personnel to make inspections abroad; and fifth, inviting foreign experts, professionals, and professors to exchange advanced technology in this province. According to rough estimates by Guangzhou City, technical personnel from 368 academic and business organizations of 17 countries and regions have been invited to give nearly 700 lectures in this province since 1978, and more than 80,000 people from all parts of the country have attended the meetings for technological exchanges.

Since 1979, in light of the needs of economic construction in this province and in the whole country, the Guangdong provincial commission for science and technology and its branch in Guangzhou City have held 26 advanced foreign technology exhibitions, which showed more than 2,000 items of advanced technology and equipment provided by more than 20 countries and regions. Academic exchange activities have been carried out during these exhibitions and have helped import technology and equipment that is useful to our country,

7614
CSO: 4008/267

NATIONAL DEVELOPMENTS

SICHUAN SENDS ENGINEERS, TECHNICIANS TO XIZANG

HK170512 Chengdu Sichuan Provincial Service in Mandarin 2300 GMT 13 Mar 85

[Text] Beginning at the end of last month, some 12,000 engineers and technicians, who are engaged in 43 projects to aid Xizang which nine provinces and municipalities throughout the country have contracted to do have entered Xizang from two places -- Chengdu and Shanghai -- successively. By 8 March, some 1,600 people had been airlifted from Chengdu to Xizang.

Due to the fact that the nine provinces and municipalities have taken the situation as a whole into consideration and have given precedence to each other out of courtesy, the air transport work has gone very smoothly. With a view to mitigating the air transport work, the workers of all provinces and municipalities who are aiding Xizang, have acted in accordance with the plans. Some workers aiding Xizang gave up an opportunity to stay at home to be with their families during the spring festival, traveled day and night, rushed to Chengdu, and entered Xizang ahead of schedule.

Some 600 workers from Shandong Province who are to aid Xizang, arrived at the beginning of March. Because they had not reported their plans for air transport, they were held up in Chengdu and could not go. Comrades of the provinces and municipalities displayed their good work style, attached importance to the overall situation, and reduced the number of seats in the planes for their own workers on their own initiative so as to meet the pressing need of the Shandong workers. Sichuan Province reduced the number of seats in the planes for its workers on its own initiative, allowed comrades from other provinces and municipalities to have seats in the planes, and mobilized its own workers to go to Xizang via Qinghai by train.

At present, the air transport work is in the peak period. The Chengdu Civil Aviation Administrative Bureau is vigorously readjusting the transport forces and, plans to arrange for 10 Boeing 707 flights and 3 IL-48 flights every week. Thus, about 1,800 people can be transported a week. It is estimated that the air transport of the workers to aid Xizang will be completed on schedule.

7705
CSO: 4008/267

NATIONAL DEVELOPMENTS

BOOK ON U.S. SCIENCE, TECHNOLOGY POLICY PUBLISHED

HK040851 Beijing RENMIN RIBAO in Chinese 1 Mar 85 p 3

[Report by Wu Derong [0702 1795 1369]: "'U.S. Science and Technology Policy, Organization, and Management' Published in China"]

[Text] The book "U.S. Science and Technology Policy, Organization, and Management" has recently been published by the Light Industry Publishing House. The writer of the book is Li Mingde of the Chinese Academy of Sciences. This book of 365,000 characters gives the readers an account of the process of the development and present situation of U.S. science and technology; U.S. Government policy, organization, management, and key research fields in science and technology; the situation in U.S. higher education; the ranks of scientific research and teaching staff, the training of postgraduates, and the characteristics of scientific research in U.S. higher education institutes; the general situation, characteristics, and management of research and development work in U.S. industrial enterprises; and so on.

6712
CSO: 4008/267

NATIONAL DEVELOPMENTS

JOINT BODIES FOR TEACHING, SCIENTIFIC RESEARCH, PRODUCTION SET UP

Tianjin KEXUEXUE YU KEXUE JISHU GUANLI [SCIENTIOLOGY AND MANAGEMENT OF SCIENCE AND TECHNOLOGY] in Chinese No 2, 12 Feb 84 pp 7-9

[Article by Yu Ren [7411 0088] of East China Chemical Engineering College: "A New Approach"]

[Text] The setting up by East China Chemical Engineering College, with the relevant enterprises of cities and counties, of joint bodies for teaching, scientific research, and production has achieved striking results. This material introduces the starting point of joint bodies, the types of joint bodies, the content of the joint body agreements, and the superiority of setting up joint bodies, and raises some problems that need to be solved if joint bodies are to continue to be developed.

East China Chemical Engineering College was the first engineering college to be set up after one college system readjustment in 1952. It now has 14 departments, 26 specialities, 4 research institutes, 2 research offices, and 2 centers for planning, testing, and analyzing. It is now forging ahead to become a socialist industrial college which has chemical engineering as its distinctive feature, which combines science and engineering, and which has many disciplines.

On 4 May 1982, when Premier Zhao Ziyang viewed the scientific and technological results of the state's institutions of higher learning and the products of school-run factories, he pointed out: "If in the future, based on its own actual teaching circumstances and the direction of its scientific research, a college can combine with a factory, there will be formed a regular joint body for teaching, scientific research, and production, or what is called a community." This is the correct way for the new circumstances for education to meet the demands of national economic development, is the fundamental way for schools of higher learning, particularly science and engineering colleges, to integrate theoretical training with reality, to apply what is learned, and to develop talent comprehensively.

A school of higher learning is one of the five sides of our country's scientific research work, and there are three contingents in the school itself: the first is the teachers, the second is the graduate students, and the third is the graduating class students. The teachers, besides fulfilling the teaching and

scientific research tasks assigned by the state and the localities, have energy to spare; graduate students with a large number of theses to write can get topics for them from the first line of production; and the graduation segment of the graduating class students can be integrated with the reality of production by making diploma-winning designs or writing graduation theses. In this way, the three contingents and three administrative levels, with the teachers being in the dominant role, can, under the guidance of the teachers, give full play to their roles. At the same time, because a school has many disciplines and many specialities, the forces of this "front army" integrate laterally with society, and the scientific and technological forces integrate vertically with all trades and professions in society, forming a network, namely, the so-called matrix structure, and the crisscrossing network and the vertical and lateral coordination will surely accelerate the progress of science and technology.

We have signed nine agreements for teaching, scientific research, and production joint bodies with Changzhou City in Jiangsu Province, Jiading County in Shanghai Municipality, and Zaozhuang City in Shandong Province, and have undertaken 55 projects, 24.1 percent of the total number of our college's current scientific research projects. Based on more than a year of practice, the teaching, scientific research, and production joint bodies may be divided into three types: large enterprises, medium-sized enterprises, and small and rural commune-brigade enterprises or border area enterprises. These three types impose different demands on schools, more or less as follows:

First type: Commissioning projects of a technical development exploitation nature; commissioning the on-the-job training of engineering technicians or class study.

Second topic: transferring the possession of scientific and technological results, the main aspects being new products, saving energy, and in-depth processing; commissioning the running of short-term training classes.

Third type: Transferring the possession of scientific and technological results, and helping put them into production so as to invigorate the economy and increase income; training technical workers.

Corresponding to these three types, there are three administrative levels in the school. The school's three contingents are organized so that the best use is made of people's talents in order to serve the first line of production.

One of the important characteristics of modern scientific and technological development is the mutual permeation and mutual overlapping of all disciplines. The formation of joint bodies outside the school promotes the emergence of joint bodies inside the school, and makes us give further consideration to setting up joint bodies between schools. Some of the major scientific research topics that we undertake often possess a highly synthetic nature, and there must be much coordination between many disciplines; several colleges have certain disciplines, each possessing its own characteristics and definite level, and if they were to be united a more dominant position could be formed. The agreement to set up the "Joint Reaction Engineering Research Institute," which

our college signed with Zhejiang University, is being carried out between schools. Recently, Professor Chen Mincheng [7115 2404 1854] of our college's Reaction Engineering Institute achieved a breakthrough in scientific research on butylene oxidative dehydrogenization, and the China Petrochemical Corporation expressed its willingness to support and subsidize this joint research institute, asking it to devote 60 to 70 percent of its forces every year to the corporation's scientific research topics. This was a new development for joint bodies.

Another development of joint bodies is the jointly run factory.

We were inspired by the relationship between a medical college and its attached hospital. If there is no attached hospital, medical personnel cannot be trained well; similarly, if a hospital does not have a medical college as a back-up force, its level of medical treatment cannot be raised high. Between a science and engineering college and a factory there is likewise this intrinsic relationship, and for this reason a new form of coalition has been tried, namely, the jointly run factory geared to rural commune-brigade industry. Compared with a joint body, it is further developed organizationally, economically, and technologically. Organizationally, a management committee is set up, in which the two sides each have a quota or representation, and it makes policy on major matters concerning the factory; economically, the two sides jointly make investments with the school mainly making the technological investment. Profits are distributed according to the proportion of investment. Technologically, the school takes on overall responsibility, including the training of technical workers internally. This form is superior to the loose coalition of a joint body. For example, after we teamed up with the Songyin Resin Factory in Jinshan, the school got from various trades and professions the task of developing ion exchange resin of different types and for different uses. After the laboratory gets the data it can conduct intermediate tests at the jointly run factory at any time. After a product tests out successfully, the factory can put it into batch production, greatly shortening the period for changing it into productive force. Thus the factory becomes a base for developing new products and provides favorable conditions for the comprehensive training of talents by the school. We envisage that a department of a school or a school that has the proper conditions will be able to get up around itself a series of jointly run factories, which will be its own teaching, scientific research, and production bases. In this way, not only can it comprehensively raise its teaching quality and scientific research level, but also it can open up a new channel for the school's economic sources.

The initiation of this new approach--the setting up of joint bodies for teaching, scientific research, and production--although not in practice for long, from a look at the initial results, has already displayed its superiority and vitality. Specifically speaking, the main merits of a joint body are: through technological consultation and the transfer of the possession of technological results, science and technology are fairly quickly turned into productive force, and the period for doing this is shortened; there is a big increase in the number of scientific research topics coming from the first line of production, and its source is stable and grows year after year, thus strengthening the connections

between school and society; scientific research is integrated with teaching, and the capability of the graduating class students to integrate theory with reality and to solve production problems is improved; the competitive ability of the products of industrial enterprises on domestic and foreign markets is improved; and good conditions are provided for the opening of channels for running schools of varied forms and for the continuing education of engineering and technical personnel in enterprises. The setting up of joint bodies has broken through the boundaries of department and regional ownership, shortened the period for turning scientific research into productive force, and has benefited the transfer of science and technology from large cities to medium-sized and small cities, from cities to rural areas, and from enterprises owned by the whole people to commune-brigade enterprises, so that schools directly serve the vigorous development of the economy, and promote the contribution of the schools of higher learning to the great goal of guadrupling the gross output value of industrial and agricultural production.

A joint body for teaching, scientific research, and production is a new thing; in its practice we feel that there are many problems that need to be explored and studied, and some problems need to be studied and solved on the leadership level.

1. For the fees for the transfer of the possession of scientific and technological results, as well as for the fees for other cooperation projects, there is not yet a unified standard, and it is to be hoped that the state will be able to formulate a unified fee standard in order to refer to it when making the transfer. In the relevant provisions in the current "Ministry of Education's Trial Regulations for Scientific and Technological Transfers by the Ministry's attached Schools of Higher Learning," the cost of scientific and technological results are calculated on the basis of the man-hour cost, materials cost, and water and electricity charges, and when there is the transfer of the possession of a scientific or technological result, the fee is 150 to 300 percent of the cost, which is obviously a depreciation of the value created by the mental work of intellectuals in science and technology.

2. Under the circumstances in which scientific and technological results are appearing in large numbers, it is urgently necessary to speed up the formulation and implementation of a patent law, and at the same time the question of the ownership of scientific and technological results awaits discussion, as there are now too many disputes about it.

3. In the transfer of the ownership of scientific and technological results, resistance has also been encountered in their popularization and application. The reasons are: the pressure of a factory's production and profit targets is very heavy, and the adoption of new technologies affects production; the cost of a factory's technological transformation and its trial-manufacture of new products is too small; some factory leaders are content with the status quo and just drift along; and some factory leaders count on importations from abroad, because the cost of importation is paid by the state, but if a factory accepts the transfer of the possession of a domestic scientific or technological result, the factory itself must foot the bill, which would affect the income and

welfare of workers and staff. This being the case, it is hoped there wil be a revision of policy so as to promote the transformation of old technologies and the adoption of new technologies.

4. The question of how schools of higher learning are to digest and absorb imported technologies has not been settled. For teachers of schools of higher learning to directly serve economic construction and train high-quality talents, they must constantly keep in touch with and master new technologies, and an important link in this is the digesting and absorption of imported technologies. However, the schools of higher learning are now encountering numerous difficulties in understanding imported technologies. After some large enterprises import technologies they keep them a secret domestically and keep them secret from the schools of higher learning. This not only causes a duplication in importation and wastes foreign exchange, but also is detrimental to the raising of the level of domestic teaching and scientific research. This is an abuse produced by regional ownership and department ownership, and it is hoped that the State Council will be able to organize college teachers to take part in the work of digesting imported technologies, and make make rational rules for college teachers to look at and study imported technologies.

(Responsible editor Chu Xiao [0443 2445])

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NATIONAL DEVELOPMENTS

SCIENTIFIC RESEARCH BY SCHOOLS OF HIGHER LEARNING VIEWED

Tianjin KEXUEXUE YU KEXUE JISHU GUANLI [SCIENTIOLOGY AND MANAGEMENT OF SCIENCE AND TECHNOLOGY] in Chinese No 2, 12 Feb 84 pp 9-10

[Article by Su Shiquan [5685 1102 2938] of the Northeast Engineering College: "The Direction for University Scientific Research"]

[Text] [boldface begins] In gearing its scientific research work to economic construction, the Northeast Engineering College made a point of proceeding from the characteristics of China's natural resources and studying new technologies that possess distinctive Chinese features. In cooperation with factories, the members of the college have developed the key products of the country; constantly transferred laboratory results to production; carried out in coordination with factories and mines the tackling of key technological problems and the effecting of technological transformation; and organized joint companies for designing, scientific research, and production and trained talents for industrial and mining enterprises. They think that, since the vigorous development of the economy depends on science and technology, gearing science and technology to economic construction is the way to make socialism and science and technology flourish and develop. Scientific research work in schools of higher learning must dare to make new paths, and the organizing of the academic echelon and its joint bodies is a powerful organizational form for the scientific research work in schools of higher learning to tackle key problems. [boldface ends]

"The vigorous development of the economy must depend on scientific and technological progress, and science and technology must be geared to economic construction"--this is an extremely correct policy. Under the guidance of this policy for the development of science and technology, we strive to display our college's superiorities in having comparatively abundant teacher strength, comparatively complete disciplines, and an integration of science and engineering, and in varied forms to serve vigorously the development of the economy and society. The first form is to make a point of proceeding from the characteristics of China's natural resources and to study new technologies that possess distinctive Chinese features. The second form is to sign contracts with factories for solving technical problems during the development of the country's key products, with both parties undertaking the task of tackling key technical problems. By taking part in this task of tackling key problems, the school

will not only fulfill the topics praised in production, but also do further theoretical work so that this scientific research will serve the purpose of replacing teaching materials and training graduate students. The third form is constantly to transfer laboratory results to production. Although the topics studied in laboratories are not the questions directly brought up in economic and social development, they proceed from the disciplines and proceed from the growing point of science and technology, and the results obtained can also be used in production. The fourth form is, in coordination with factories and mines, to carry out the tackling of key technical points and effect technological transformation; to organize and design joint companies for scientific research and production, and to train talents for the industrial and mining enterprises. For example, our college has signed with the Anshan Iron and Steel Company a comprehensive technical cooperation agreement, which includes: technical consultation, scientific research, and the tackling of key problems, personnel training, technical interchange, as well as the provision of convenient conditions for the other party's teaching, scientific research, and production. Since the agreement was signed, a little over 30 scientific research topics have been initiated, and some of them have already borne results. Facts have shown that, for the school and the factory to be able to maintain a basis of cooperation over a long period, besides the attention and support of the leading comrades of the two sides, there must be cooperation between the sides in their scientific and technical superiorities. The factory feels that it needs the school's new technologies, and the school's teachers feel that they can accomplish something in the factory; if there is a lack of enthusiasm on one side, the cooperation cannot be maintained.

Our understanding of how university scientific research should serve economic and social development is:

1. [boldface begins] "The vigorous development of the economy depends on scientific and technological progress, and science and technology serve production"--this is the way for the socialist society and for science and technology to flourish and develop. [boldface ends]

To build a socialist society with distinctive features, there are many new problems in the production, economic, and social aspects that urgently await resolution. And these lines for development of science and technology that proceed from China's national conditions must have distinctive Chinese characteristics. For example: modernized production only requires a fairly small number of people, and with our population being so big, how can we give equal consideration to both aspects? To solve this problem, under ordinary circumstances, China must not take the path of foreign countries, in which machines replace people, but rather should take the path of people-machine systems, in which people are integrated with computers. And people-machine systems is a discipline in which control theory, information theory, and systems theory is integrated with psychology and dialectical logic as well as formal logic. Therefore, to meet the needs of China's economic and social development, we must have sciences and technologies with our own distinctive features. The development of these sciences and technologies will certainly promote economic and social development. The two are cause and effect, and can jointly flourish and develop.

[boldface begins] The academic echelon and its joint bodies are a powerful organizational form for the scientific research and tackling of key problems in schools of higher learning. [boldface ends]

In developing the scientific research of schools of higher learning, we must build well the scientific research ranks well, particularly getting a good grip on the building of the backbone element ranks. In the past several years, we have strengthened the building of the academic echelon and its joint bodies. The so-called academic echelon is an academic collective which has the leading people in a discipline, which has a completely coordinated intellectual structure, and which is composed of young, middle-aged, and old teachers, technicians and workers, and graduate students, all in this discipline. It is the smallest unit in which scientific research is organized in the same direction. Our college has selected leading academic people and provided them with assistants, who have formed academic echelons. These echelons form the backbone ranks for our college's scientific research; the key scientific research that they undertake is highly difficult and large in quantity, and results are achieved fast and to a high level of quality. However, because of the development of the modern economy, many scientific and technological problems are topics of a comprehensive nature. For example, energy source computer management and control systems include computer hardware, computer regional and area network technology, digitial communication technology, digital instruments and meters, various kinds of technical measures to save energy resources, as well as a large amount of supplied software design. This relates to computer application, to the use of automatic control, automated instruments, and thermal energy, and to coordination between digital communications and systems engineering and other disciplines. This is a problem that the echelon of one certain discipline would find hard to solve, and when we encounter a topic of this comprehensive nature, we organize a multi-layered, multi-echelon joint body, which acts as a nucleus and command post for jointly tackling key problems.

When the Fushun Iron and Steel Company was working on assimilating five pieces of imported equipment, our college undertook the task of assimilating the VHC essence converter. We organized many disciplines in the college, including steel smelting, electrical metalurgy, vacuum, hydraulic pressure, metal physics, and automation, to jointly tackle the key problem, and the results of our research in the development of the VHC technology reached international standards.

[boldface begins] In gearing scientific research to production reality, we must dare to go out of our own familiar field, constantly renew our knowledge, and do creative work. [boldface ends]

The development of modern science and technology changes with each passing day, and the requirements of modern Chinese society become increasingly varied. The departments of learning formed in history cannot completely satisfy the requirements for construction of socialist modernization. For example, the systems engineering scientific research team undertook research on "the readjusted relationship between Liaoning Province's energy sources and industrial structure." They developed an industrial-structure-energy source model, and on the

computer test-computed 485 plans for industrial development in the province in 1985, putting forward, under conditions in which the amount of energy supply will not increase much, possible plans for the industrial structure and for energy saving to make the rate of industrial development attain a level of more than 5 percent, and further explored the changing trends in the industrial structure to the year 2000. This took them completely out of the field of their original discipline of towing automatic control. To fill the gaps in disciplines, some persons were required to leave their own familiar field and advance into new fields, such as economic systems, information systems engineering, and urban planning and construction. Many disciplines are now taking in the achievements of other disciplines in the search for technological progress; those that study economics have advanced to the study of econometrics, and those that study process metallurgy have advanced to the study of metallurgical kinetics. In brief, going from the static state to the dynamic state, from the qualitative to the quantitative, and from one discipline to another discipline--this is contemporary production and economic development, and it imposes new demands on science.

4. [boldface begins] Various forms of factory-school scientific and technological coordination should be adopted. [boldface ends] Coordination between factory and school must depend on the close cooperation and enthusiasm of the two sides. Not only are the school and the factory different, there are fairly many differences between one factory and another in production tasks, technical forces, and equipment level. Therefore, we should proceed from reality in adopting various forms of coordination and develop scientific and technological coordination between factory and school. In the past several years, our college has mainly adopted the following three forms:

a. The topic (or subtopic) contracted by the schools with a factory or mine is independently fulfilled by the school.

b. For a large topic or a transformation project, the school undertakes to tackle the key technical problems, and the factory or mine is responsible for implementation.

c. The school only provides technical consultation, or tests and examines data and materials.

Because varied forms are adopted, the coordination between factory and school has developed swiftly. In the past 3 years our college's scientific research work has been geared to 24 provinces, municipalities, and autonomous regions in the country; cooperative relations in scientific research have been established with a little over 150 factory and mine enterprises; and professional ties for technical service have been established with a little over 1,500 units.

The first of the four forms mentioned above is suitable for a school which has complete scientific echelons, which has experimental equipment and means, and which has the forces to fulfill a task by itself, and for a problem that a factory or mine is unable to solve. The second form is suitable for a factory which has certain technical forces but not strong ones, and thus technologically

it mainly relies on the school. The third form is used when the factory or mine has the technical forces to complete a task independently, and only needs the school to help and advise or give assistance. But, no matter what form is used, we adopt the form of a contract, in which are specifically stipulated the responsibilities, rights, and interests, the planned speed and costs, and the compensation and awards for the factory and the school. Thus the relations of coordination are insured, and coordination in the completion of scientific research is promoted. In short, the scope of our country's construction of socialist modernization is extremely broad, and the demands for scientific and technological progress are also extremely urgent. Only if the scientific and technological forces of the schools of higher learning constantly renew their knowledge, develop marginal and comprehensive disciplines, advance in depth and breadth in science and technology, and form research and experimental centers with the distinctive features of the whole country will they be able to make fairly big contributions to economic and social development. And the construction of this kind of research and experiemental center urgently requires the attention and support of the leaders of the relevant departments. We believe that, in the construction of the four modernizations, the schools of higher learning will make their proper contributions to our country's quadrupling of the gross output value of industry and agriculture.

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NATIONAL DEVELOPMENTS

QUESTION OF COUNTY SCIENCE, TECHNOLOGY COMMISSIONS EXAMINED

Tianjin KEXUEXUE YU KEXUE JISHU GUANLI [SCIENTIOLOGY AND MANAGEMENT OF SCIENCE AND TECHNOLOGY] in Chinese No 2, 12 Feb 84 pp 26-32

[Article by the Hubei Provincial Scientific and Technological Commission and the staff editorial department: "An Important Topic in Our Country's Building of Its Scientific and Technological Management System"]

[Text] Based on the basic principles of Marxism and our country's reality, the 12th CPC Congress raised the development of science and technology to an unprecedentedly high level of strategy, so that our country's scientific and technological undertakings have entered a new period of development. The role of science and technology in promoting economic and social development is daily and clearly being demonstrated, and scientific and technological work is drawing people's attention more and more.

However, people's understanding of the importance of strengthening "science and technology" is still fairly superficial. The understanding of the important position and role of science and technology commissions in strengthening "science and technology management" is also very vague. In particular, the understanding of the position and role of county science and technology commissions in strengthening rural science and technology management and promoting the progress of agricultural science and technology and economic development is even more inadequate, and this is not only a serious ideological obstacle to strengthening the building of county science and technology commissions, but also has an extremely adverse effect on the overall building of the entire country's science and technology management system. Therefore, the study of the question of county science and technology commissions is an important topic in perfecting our country's system of science and technology management.

For a long time, many county science and technology commissions were in a state of the "duties not being understood, responsibilities and rights not being clear, personnel being slack, and organizations not being perfected." On the surface people felt that they were "project science and technology commissions" and were not essential; they themselves felt weak in power and as if they were nothing. This actual state of affairs was highly unsuited to the demand for vigorous economic development, and was far from meeting the needs for agricultural development and the overall construction of the rural areas. Therefore, the study of the question of county science and technology commissions is an extremely urgent task facing us. When reforming county-level organizations, the study of this question possesses even more practical significance.

First of all, we must study its characteristics. Only after people grasp the essential characteristics of any thing can they effectively apply and control it. Similarly, only after understanding the characteristics of a county science and technology system can full play be given to its role. Because a county science and technology commission is placed in a crisscrossing complex situation, in the study of its characteristics it needs to be analyzed from various different angles. For example, analyzing it from the angle of the state's science and technology system and the county government's management system, analyzing it from the angle of the science-technology-production process or the stages in scientific and technological progress, and analyzing it from the angle of the demands imposed on science and technology management by agricultural development and the overall consturction of the rural areas. This is the basis for our study of the work of county science and technology commissions.

Next is the study of the functions of a county science and technology commission and the authority needed to perform its functions. If a unit or organization does not have a specific function, it loses the reason for its existence; if it does not have the corresponding authority to exercise its function, it cannot comlete its special task. The principle of equity must be practiced in the relationship between a function and its authority, and the authority can neither be smaller nor larger than the function. In the past, many places made clear from different angles the function of a county science and technology commission. However, because they did not give it an appropriate authority, they made it very difficult for it to give play to its function, and its work was greatly damaged. This is an important lesson that we must draw during this organizational reform.

After we understand its characteristics and specific properties and become clear about its functions and scope, we will study the building of a county science and technology commission itself. This includes: selecting and deploying leading groups (this is the core of this work of organizational reform) and working personnel; and striving to make a county science and technology commission become a capable, vigorous, highly efficient comprehensive department (organization) for science and technology management.

To usher in a new situation, and at the same time to strengthen the commission's own construction, we must study ways and means for ushering in a new situation. Based on the actual problems in the past work of a county science and technology commission, it is important to make clear the guiding ideology in management. We think that, in the guiding ideology for management, besides following the new policy for the development of science and technology that has been determined by the central authorities, there must be a big change in guiding ideology for specific management work, namely, changing from management that makes research projects the center to overall science and technology management that takes development strategy as its guide (this means that a good grip must first be gotten on strategy and planning work). This means grasping with two hands. One hand grasps the macroscopic management, which means, through implementing the principles and policies and the series of relevant rules, systems, and methods for the development of science and technology, and formulating specific measures integrated with the actual circumstances in the county, to put the scientific and technological work of the entire county on a centralized track.

The other hand grasps microscopic management, which means, centering on the technological problems that urgently need to be solved in the building of the rural economy, to organize work for tackling key problems and developing and to mediate disputes for the sake of building the national economy. This is a measure of a general character that county science and technology commissions in all places must take.

In brief, a county science and technology commission is still an imperfect, immature organization, and there are very many problems that must be studied and solved. We hope that the party and government at all levels will attach importance to studying the question of county science and technology commissions, and show an interest in and help them solve their problems. A county science and technology commission must also conscientiously study itself, improve its work, and strive, through organizational reform, to create a new situation in scientific and technological appear at the county level.

The Specific Characteristics of County Science and Technology Commissions in the National Science and Technology Management System

Management is divided into layers and has energy levels. Looked at vertically, in the national science and technology managment system, there are the State Science and Technology Commission, the provincial science and technology commissions, and the county science and technology commissions; looked at horizontally, in the county's science and technology management system, there are commune-brigade science and technology management, department science and technology management, and research unit science and technology management. Looked at from the viewpoint of systems theory, a county science and technology system is placed in the two big management systems of the local governments and the science and technology commissions throughout the country, and within the county's science and technology management system it is the highest level but within the science and technology commissions' management system it is the basic level.

The more than 2,700 county science and technology commissions throughout the country are scattered over the broad rural areas and city suburbs; the economic, technological, and social conditions they face are not the same; and their work environments differ in innumerable ways. Also, they are closer to industrial and agricultural production, their actual problems are intricate, and they have their own specific characteristics as distinct from those of the state and provincial science and technology commissions.

Although the basic function of management at all levels is the same, because the scopes of jurisdiction are different and the problems needed to be solved are different, there are some differences in the content of management. For example, in formulating principles and policies, the higher the level of the science and technology commission, the stronger its principled nature and the more work it has in this aspect, and the county-level science and technology commission must integrate the principles and policies with the local situation and thoroughly implement them. Again, for example, the State Science and Technology Commission and the provincial science and technology commissions engage

in theoretical research and applied research, and have many highly sophisticated projects, but the county science and technology commissions engage in developmental research for technological transformation, and has projects of a strong applicability nature. In brief, the county science and technology commission plays a role that the State Science and Technology Commission and the provincial science and technology commissions cannot replace.

Even more important is that, viewed from the strategic height of the country's overall development, the function and role of the county science and technology commissions directly relate to the raising of the scientific and technological level of the 800 million peasants and the exploitation of the abundant national resources on the country's 9.6 million square kilometers, and have a bearing on the modernization of our country's agriculture and even on the progress of the "four modernizations." Therefore, we must, proceeding from China's national conditions, study and build our country's special integrated, scientific, local science and technology management system. However, at present our country's science and technology commissions--this management system--are not an integrated, stable structure. In form, they are related by direct lines from the State Science and Technology Commission to the provincial science and technology commissions and then to the county science and technology commissions, but these are all "imaginary lines," and they are only linked by the topics of "plans for scientific and technological projects," which either exist or not. Essentially, they do not truly form a system, and this causes the management of the science and technology commission system to not be a controlled, closed-type management but rather an uncontrolled or out-of-control, open-type management. If the county science and technology commissions operate in this "out-of-control" system, it is bound to cause the problems that now exist to different degrees, for example: the organization's system is not sound; duties are not understood and authority varies; and the leading groups are weak, there are few managerial personnel, and the managerial personnel structure has not yet been specialized. These problems have already seriously hindered the display of the function and role of the county science and technology commissions. If we only give consideration to the raising of the scientific and technological level at the state and provincial level, we will cause this system to become lopsided.

We hope that, in this reform, we will be able to draw a high degree of attention, and earnestly and conscientiously build the county science and technology commissions well, advance step by step in the setting up of a national science and technology management system that has clear levels, has a rational division of work, is linked up from head to tail, is linked vertically and horizontally, and is commanded agilely and effectively; and gradually form a structure that is effectively linked from science to production, from research and development to transfer and popularization, which will promote the rapid development of scientific and technological undertakings.

Looking at the Importance of the Work of Science and Technology Commission Strategy and Planning From the Process of Management

The process of the work and science and technology management can be divided into: investigation and study forecasts, tentative ideas for strategy, developmental plans, short-term plans (annual plans), as well as planned organization

and implementation (including manpower and qualifications) at the main links in directing the science and technology toward transformation into production. If we look upon investigation and study forecasts as a method, then the tentative idea for strategy and the developmental plan become the chief link in the management process. Without this chief link there will be created a situation of "a blind man riding a blind horse--at midnight they will be on the edge of a deep pond." If this link is bad, then one mistake will lead to a hundred mistakes, and there will easily be created a situation of "being off in the least bit causes a difference of a thousand kilometers." Therefore, in management the strategic plan is the factory that plays the decisive role.

A country is a whole, a province is a whole, and a county is also a whole; a country has long-term major problems, a province has long-term major problems, and a county likewise has long-term major problems. A strategy and a plan for science and technology are not just had by a country and a province; a county also should have them. A county science and technology commission acts as a comprehensive department for the work of managing science and technology of the government at the same level, and in the management, without exception, the function of management must be carried out, and especially there must be good strategic work. With a strategy and a plan, there will be targets, focal points, measures, and steps for the entire county's development of science and technology, and it will be able to carry out effective management and extricate itself from a passive situation. The county science and technology commission will then be able to provide the county's party committee and government with a reliable, scientific suggestions of a policymaking nature, and will be able to effectively display its role as an adviser. This determines that the county science and technology commission must initiate research and planning work that grasps the strategy for the development of science and technology there, and which grasps the whole and surveys the overall situation.

At the same time, following the upsurge in overall construction of the rural areas, the county science and technology commission not only must keep in mind the fields of agriculture, forestry, animal husbandry, sideline production, and fishery, but also must keep in mind the fields of industry, communications, construction, energy, culture, and public health; not only must study rational structures in all professions, but also must study the coordinated development of all fields. This obviously makes the work of strategy and planning for science and technology at the county level more necessary and extremely urgent.

Formerly, our understanding of the importance of strategy and plans was extremely deficient. There was little management work done in the aspect of developing strategy, but a lot of management work done in the tactical and campaign aspects, so the management work lacked the nature of a whole, lacked continuity, and created the problem of few results and bad effects, and it cannot be said that a principal reason for the problem was not the lack of strategy and plans.

The Multiplicity of Authority in the Management of County Science and Technology Commissions

The modern management of science gradually divides the authority of management departments into three types, namely, straight-line authority, advisory authority, and functional authority.

The multiplicity of a county science technology commission in its management authority is determined by the nature and task of a county science and technology commission and the special position it occupies. The multiplicity is suited to the difficulty of the management task, the extensiveness of the management content, the complexity of the management objects, as well as the administrative layer nature of the management system. If the multiplicity of the management authority of a county science and technology commission is fully understood, then in work, based on different specific management tasks and contents, the commission will comprehensively exercise these authorities and thus be able to display better its comprehensive functional role.

The advisory authority of a county science and technology commission mainly includes investigating, studying, and forecasting the trend and direction of the development of science and technology in the county, as well as the effects on economic and social development there; proposing to the county government tentative ideas and policymaking suggestions for scientific and technological development; inspecting the implementation of the policies and principles for scientific and technological development, reporting the findings to the higher level department in charge, and, at the same time, drafting and drawing up for the county government specific measures and methods that suit reality; and so forth. The functional authority of a county science and technology commission is to assign the relevant work of science and technology managment and planning to the various communes (townships), departments, and scientific research units, and to guide the launching of science and technology management work in all aspects throughout the county. The straight-line authority of a county and technology commission includes drawing up the developmental plans and annual plans for the county's science and technology, organizing the coordinated tackling of key problems in major developmental research projects of an overall and comprehensive nature, centrally managing and controlling the assessment and awards for county-level scientific and technological results, and so forth. The three types of authority in the management function of a county science and technology commission comprise a whole. For example: if there were only the advisory authority, the county science and technology commission would be lowered to the position of an advisory organization; if only the straight-line authority were exercised, the county science and technology commission would be equated to an ordinary professional department or scientific research unit; and if there were no functional authority, the work of science and technology management would certainly fall into a circle of busy routine work. Conversely, if a science and technology commission did not have advisory authority, the work of science and technology management would lose its direction and strategic foresight; if it did not have straight-line authority, it would become a weak organization that issued empty manifestoes or appeals.

Currently, the situation in the majority of the county science and technology commissions is not suited to their multiplicity in management authority, and therefore, in the reform of county-level organizations, the local governments should, based on the characteristics of the multiplicity of the authority of science and technology commissions, bestow upon them the corresponding authority to successfully fulfill their duties.

Looking at the Duties of County and Science Technology Commissions From the Transformation Process of Science-Technology-Production

Agricultural production and the overall construction of the rural areas relate to the economic development of the entire country. A county science and technology commission carries out overall management and comprehensive utilization of science and technology and displays the force of science and technology, promotes scientific and technological progress, and pushes forward the economic construction of the entire county; these are the actual requirements for current production development and the requirements for the long-term interests of economic development.

Below we analyze the management interval (or scope) of a county science and technology commission in the science-technology-production transformation process, and this analysis will be beneficial for the strengthening of the construction of county science and technology commissions.

As the diagram shows, we divide this process into scientific analysis, technological activities, and production activities (the transition from nature to science to technology is called applied research, the transition from technology to production is called developmental research, and the transition from production to the market is called production (or product) research).

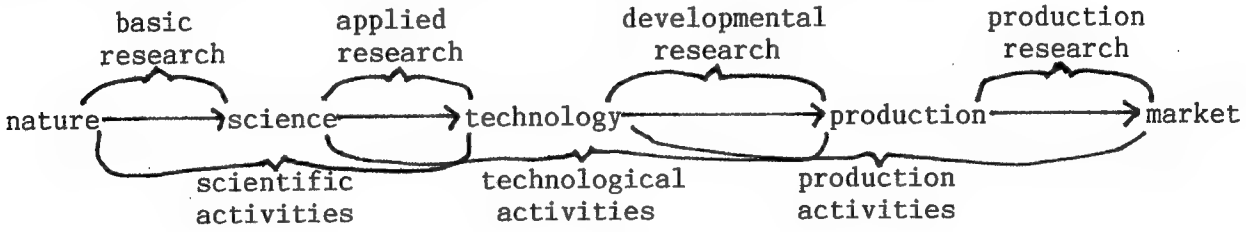


Diagram 1

At the county level, the most important task is to develop production, and the county science and technology commission is an organization that has the authority to manage science and technology and is not a department that directly manages production. It only manages one part--technological activities--of this process, and must not manage this entire process. In actual work we can see that the scientific and technological results given awards by some county science and technology commissions are basically results of developmental research.

To grasp the key points in the management of technological activities it is necessary to make the following dissection of these activities. As Diagram 2 shows, looking at them dynamically, technological activities can be divided into three processes: the process of technological experimentation, the process of technological authentication, and the process of technological application. From Diagram 2, we can clearly see: a county science and technology commission should make primary the development and application of technology.

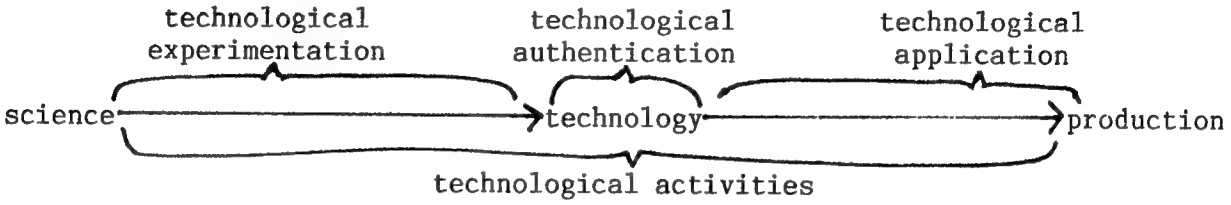


Diagram 2

However, a county science and technology commission cannot manage the application of technology in all aspects, and in its management of technological application it must have an emphasis. From looking statisically at technological authentication, the point of emphasis stands out. As Diagram 3 shows, technological authentication can be broken down into: Technologies already authenticated (namely, technological results), technologies now being authenticated, and technologies still awaiting authentication. The county science and technology commission should make the managment of the production and application of "technologies already authenticated" (namely, technological results) its key point. At the same time it should vigorously manage the understanding and mastery of "technologies now being authenticated."

technologies already authenticated
technologies now being authenticated
technologies still awaiting authentication

Diagram 3

Speaking up to this point, we may say that a county science and technology commission should, with management of technical activities made primary, should make the management of the transformation from technology to production an important task, and make the introduction of technological results into applicatin in the county's production the focal point of its work.

Discussion of the Functions of a County Science and Technology Commission

Because the county science and technology commissions of our country have not been set up for long, have suffered several setbacks, and lack thorough, systematic research, many persons have a confused understanding about the functions of a commission, and for a long time there has existed the phenomenon

of its duties not being clear and its responsibilities and authority being varied. In recent years, workers in science and technology management in many localities have made explorations from different sides: some think the main thing is to get a grip on the management of projects in science and technology planning; some advocate that emphasis be put on the work of experimentation, demonstration, and popularization; still others have proposed that attention be put on the coordinated tackling of key scientific and technological problems; and so forth. We think that, in the current reform of county-level organizations, in order to strengthen the construction of county science and technology commissions, it is necessary to make additional explorations of a commission's functions.

Functions of a county science and technology commission:

1. It is responsible, within the scope of the entire county, for implementing the party's scientific and technological policies, carrying out all its principles, putting into effect the relevant rules and regulations, and supervising and speeding up the inspection of the situation with regard to implementation in all communes (townships) and departments. It initiates research work on the locality's scientific and technological policies and economic development policies, puts forward strategic ideas and policymaking suggestion for the scientific and technological development there, and drafts and draws up specific measures and methods that integrate with the reality of the place.

2. On the basis of its investigation and research, together with the relevant departments it formulates the plans for the county's scientific and technological development, and draws up the annual plans (including the plans for the key scientific and technological projects and the testing and demonstration plans for the popularization of scientific and technological results); it distributes and manages the three items of funds for science and technology and the funds for local science and technology; and it organizes the scientific and technological forces of the entire county, coordinates the relations between the various departments, and carries out the coordinated tackling of key problems in key projects.

3. It formulates the methods for the county to award scientific and technological results; centrally manages the collection, authentication, and reporting to higher authorities of scientific and technological results, and the importation from outside of advanced scientific and technological results; sponsors the county-level awards for scientific and technological results; and examines and verifies the scientific and technological results given awards by all communes (townships) and departments, and corrects awards that do not qualify or that are issued recklessly.

4. It is responsible for the examination, assessment, and promotion of scientific and technological cadres with respect to their technical titles; organizes and deploys the scientific and technological personnel to take part in scientific and technological programs; and organizes the relevant departments to conduct technical examinations for, and issue technical examination certificates to, the technical backbone elements and innovation experts among the worker and peasant masses.

5. It organizes the collection and arrangement of scientific and technological information, sets up a local scientific and technological information network, and initiates the work of information investigation and study and advisory service; and manages application for and distribution of the materials, equipment, and instruments needed for scientific research, and organizes the coordinated joint use of large instruments and pieces of equipment, and the work in the relevant aspects of scientific and technological service and conditions.

Build the County Science and Technology Commissions Into Highly Efficient Organizations for Managing Science and Technology in the Rural Areas

At present the science and technology management of some county science and technology commissions is fairly disordered, their efficiency is not high, and they cannot carry out very well the function of comprehensive management of science and technology. Tracing the many reasons for this, we must say that the important reasons for that the accomplishment of managerial cadres are poor and that the facilities of the organizations are imperfect. In order to adapt the commissions to the excellent situation of the scientific and technological development in the great number of rural areas, so that scientific and technological work better serves the development of the economy, the backward appearance of the rural areas is thoroughly changed, and there is overall construction of new socialist rural areas, the building of county science and technology commissions into highly efficient organizations for science and technology management brooks no delay.

1. Select and apportion strong leading groups.

The overall function of science and technology management requires that the responsible persons of county science and technology commissions, besides possessing the political quality, organizational quality, ability, and moral character and work style of ordinary leading cadres, have a fairly high scientific and technological level and knowledge of science and technology management.

A county science and technology commission is the multitrade, multidiscipline comprehensive function organization, horizontally connecting agriculture, forestry, animal husbandry, fishery, industry and communications, culture and public health, and vertically connecting the tasks of scientific and technological investigation and study, the making of science and technology development plans, the popularization and application of scientific and technological results, and the effective management of good scientific and technological personnel. This requires that its responsible persons possess specialized knowledge of natural sciences, possess extensive knowledge of social sciences; even more they must have a certain amount of knowledge and capability for the management of modernized science and technology.

In view of the fact that scientific and technological undertakings are being developed, the management theory for guiding management work is not yet mature, there still exist in society the effects of certain ultraleft ideological

trends and the idea of underestimating science and technology, and the county science and technology commissions are at the most basic level of the science and technology commission system--under the circumstances of these many limiting factors--we think that it is very necessary in the leading groups of the science and technology commissions to have comrades who possess a fairly high academic level.

We suggest that, when fitting out the leading groups of the science and technology commissions, the organization departments of the county party committees, besides paying attention to the abovementioned individual qualifications in the selection of the members, should give overall consideration to their temperment, aspirations, merits and demerits. If between the responsible persons there is a unity of temperments, they have similar interests and tastes, and the weak points of one is made up by the strong point of another, this will be beneficial to their unity in fighting and to improving their efficacy in management. Conversely, to put together people whose temperments clash, whose interests and tastes are widely different, and whose strong and weak points do not offset each other will inevitably make for bad unity, cancel out strengths, and weaken management. Furthermore, we must change the modus operandi of the past in which on too many occasions some old, sick cadres were named to fill the posts of responsible persons of science and technology commissions.

2. Build a highly proficient working group.

At present, although some counties have improved the personnel makeup of the working group of the county science and technology commission, in many places the makeup is still unsuitable and problems exist as before, which, during the organization reform, must be conscientiously solved. When specifically providing personnel, special attention should be paid to the following qualifications:

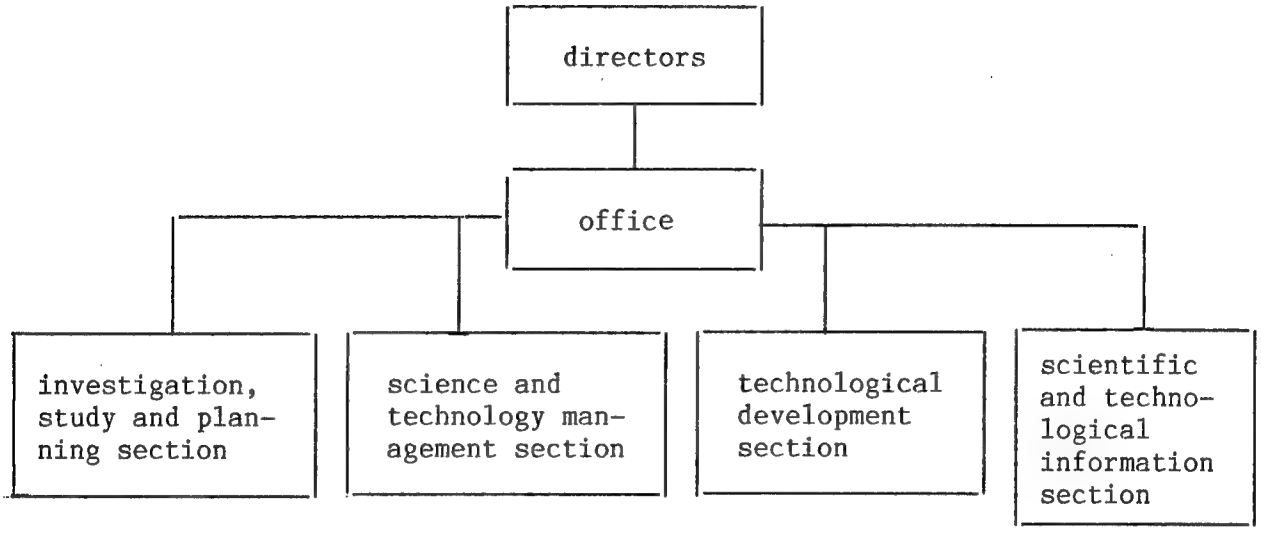
a. Intellectual composition. Besides being able to do logistics work, the working personnel of the county science and technology commissions should have a technical secondary school education or higher. It would be good if their proportion of college and technical secondary school education was 3:2, and it would be good if their specialties were agriculture, biology, physics, and machinery.

b. Ability to write. Because in the collection, arrangement, and transmission of scientific and technological information and news, in the working out of various plans, in the authentication of results, and in the compilation of various kinds of materials, there is a large amount of written work, more than half the number of working personnel in science and technology commissions should possess fairly strong writing ability.

c. Ability to organize and to express oneself. Science and technology management permeates all aspects of science and technology, the economy, and the society. The education and training of personnel who undertake science and technology managment involves scientific and technology planning for all trades and management of results. If they do not have a certain amount of ability to organize and ability to express themselves in language, they will be unable to be competent.

3. Authorized strength and organization.

In county science and technology commissions, personnel should be grouped according to the three grades of counties, A, B, C, (county population); 15 to 20 persons are suitable for one commission; and the commission will have 4 sections and 1 office, as the diagram shows.



Directors: two persons, responsible for overall work.

Office: three to four persons, manage administration and logistics.

Investigation, Study and Planning Section: four to give persons, organize investigation, study, and forecasts; draw up plans; manage funds.

Science and Technology Management Section: two to three persons, manage results and talents.

Technological Development Section: three to four persons, responsible for the work of organizing projects and tackling key problems in them, of effecting technological transformation, and of applying and popularizing results and for equipment allocation.

Scientific and Technological Information Section: one to two persons, responsible for information work.

4. Accurate selection of breakthrough points for highly efficient management.

Through studying management theory and summing up the experiences and lessons of management work in county science and technology commissions, we have discussed the problem of how to accurately select breakthrough points. We think that management workers of county science and technology commissions, on the basis of studying knowledge pertaining to science and technology management

and of heightening their understanding of the important position and role of science and technology management (they should understand that the strategy, tactics, plans, and policies for scientific and technological development in the county has a chief, guiding, and macro-position and role in the entire content of science and technology management, and that only if the tackling of key technical problems and the effecting of technological transformation is carried out under the guidance of scientific strategic thought will it have long-range, optimal economic and social results) should get a tight grip on work in two aspects:

The first aspect is to concentrate the scientific and technological forces in the county to get deeply involved in investigation and study of reality, propose strategies for scientific and technological development, and formulate plans for the development of science and technology and the relevant technological policies, acting as good "staff officers" for the county's party committee and government on these major questions.

The second aspect is, under the guidance of strategic thinking, to accurately understand the principal weak links and to select projects in breakthrough points that have the distinctive features of the locality and are of strategic significance, and that are comprehensive (contain a structure for industrial enhancement) key projects that tackle key problems, do research, or make experiments. Afterward, as required by the comprehensive projects, they are to select certain key tactical problems to tackle and single research and testing projects, or to organize relevant technological transformation, so as to promote the progress of technological transformation in the rural areas, overall construction of the rural areas, and agricultural modernization.

Editor's afterword: This manuscript was written on the basis of the discussion meeting on the "work of county science and technology commissions" held by the Science Technology Commission of Hubei Province in Dangyang County in the middle of November last year. Editors of our periodical took part in this discussion meeting and organized this special column. The comrades who took part in writing this manuscript were: Ouyang Shitao [2962 7122 0013 3447] and Hu Xinfa [5170 2450 7569] of the Science and Technology Commission of Hubei Province; Wang Jian [3769 0494], Peng Huaxian [1756 2450 7569] and Wei Mingguang [0604 2494 0342] of the Science and Technology Commission of Yichang Prefecture; Li Zhonghan [2621 0022 3352] and Lu Jiming [4151 4949 2494] of the Science and Technology Commission of Dangyang County; Xu Chengjian [6070 2110 7003] of the Science and Technology Commission of Xiaogan County; Wang Yanshi [3769 6056 1395] of the Science and Technology Commission of Yicheng County; Wang Shifa [3076 6108 7569] of the Science and Technology Commission of Changyang County; and Pei Hongneng [5952 1347 5174] of the Science and Technology Commission of Yichang County.

(Responsible editor Wan Li [5502 0500])

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NATIONAL DEVELOPMENTS

JIAOTONG UNIVERSITY INTEGRATES SCIENTIFIC RESEARCH, PRODUCTION

Tianjin KEXUEXUE YU KEXUE JISHU GUANLI [SCIENTIOLOGY AND MANAGEMENT OF SCIENCE AND TECHNOLOGY] in Chinese No 2, 12 Feb 84 pp 5-7

Article by Shanghai Jiaotong University: "Break Down Barriers, Effect a Coalition of Scientific Research and Production"]

[Text] In the past several years, in its scientific and technological work, the Shanghai Jiaotong University has adopted many forms geared to economic construction for serving the economy, including: strengthening applied research; practicing the scientific research contract system; actively seeking scientific research topics in production practice; breaking down the barriers between departments, areas, and professions, and effecting many forms of coalition between teaching, scientific research, and production; initiating with Xijiang comprehensive scientific and technological coordination to support border area construction; and gearing itself to society in initiating technological services. Their understanding is: the reform of the school's management system has promoted the integration of scientific and technological work with economic construction; and the gearing of scientific and technological work to economic construction has also promoted the initiation of scientific and technological work in the school and the raising of its educational level. They think that in the integration they must both obtain certain economic interests for the school and have in mind the promotion of the development of science and technology.

A school of higher education is both an important base for training scientific and technological talents and an important front army for developing science and technology. Proceeding from the basic purpose of scientific research, the national condition of our country, and the actual needs of economic construction, the promotion of the development of the national economy is similarly an important task in the scientific and technological work of a school of higher education. Through the following patterns and ways, our school has closely integrated its scientific and technological work with the spurring on of the progress of production technology, improving economic results, and promoting the development of the national economy.

1. By signing scientific and technological cooperation agreements with relevant provincial, city, and county people's governments or industrial departments, it has promoted the relevant integration of "vigorous economic development must depend on science and technology" and "scientific and technological work must be geared to economic construction."

With the Xinjiang Autonomous Region Government, the Shandong Provincial Shipbuilding Industry Company, the Xiangfan City People's Government, Dongjing City's Economic Commission and Scientific and Technological Commission, and the Mengxian County People's Government in Henan, our school has signed long-term scientific and technological cooperation agreements, which stipulate the content and pattern of cooperation, the distribution of funds and economic results, and the organization and coordination. With regard to the scientific and technological cooperation with the Xinjiang Autonomous Region, our school has organized and implemented support for the important matter of the building of border areas and the strengthening and safeguarding of the border areas. Comrade Wang Zhen [3769 7201], chairman of the school's administrative affairs committee, has shown extreme concern about and attached importance to this matter, making important directives. The school's party committee secretary has personally gone to Xinjiang to make an investigation, signed comprehensive scientific and technological agreements with the autonomous region, and sent at various times delegations made up of responsible persons of offices and departments of the school, full and associate professors, and teachers of 16 specialities to 4 commissions, 2 offices, 11 departments and bureaus, and 3 prefectures and cities for situation briefings. They made on-the-spot inspections of Turpan and Shihezi prefectures, made on-the-spot visits to 24 units, separately held technological discussions, and implemented specific scientific and technological cooperation projects. In the scientific research aspect, our school has now undertaken 18 research topics. For example, research on the "long-range plan for national economic development in Xinjiang to the year 2000" (research expenses required for the period March 1983-December 1985 are 190,000) is our school's gratis support of Xinjiang, and the first stage of the research will be completed at the end of February 1984. In the research topic "processing of aerial remote-sensing photographs (3,500 photographs) of the natural resources of the Tali River Valley in Xinjiang," the technology is highly difficult and there is a lot of work, and for it our school only received the research costs. Thirty-one research offices of our school made it their chief task. In the aspects of personnel allocation, instrument and equipment utilization, and logistical support, they have given the topic priority in their arrangements and support, and hope to fully complete it in August 1984. In the aspect of training scientific and technological talents, our school's industrial management department has already sent full and associate professors and nine teachers to Xinjiang to run 3-month first-term training classes for managerial cadres, intending through this form to help Xinjiang to gradually set up training centers for managerial cadres; and the school has agreed to enroll factory directors and managers from Xinjiang in the school to study enterprise management, with each term being 2 years for an enrollment of 20 persons. The scientific and technological foreign languages department in 1982 and 1983 enrolled 50 students from Xinjiang each year for directed training to become qualified in foreign languages. The image processing office and

the systems engineering study classes for leading cadres of the relevant scientific and technological personnel. This year and next year, our school will receive about 50 teachers of 6 schools of higher education in Xinjiang who will take refresher courses in 35 subjects, and will send experienced teachers to Xinjiang to undertake teaching tasks in 10 courses at 5 schools of higher education. It has also initialed an "agreement to train M.A. postgraduate students" for Xinjiang, under which, for the period from September 1983 to February 1986, it will train nine postgraduate students in systems engineering and industrial management. To support the building of schools of higher education in Xinjiang, our school will provide gratis to Xinjiang 262 instruments and pieces of equipment and over 10,000 books connected to 4 book monitoring systems.

2. The school and industry and mining (or research organizations of industrial departments) each disply their own superiorities and initiate cooperative research.

Science and technology are the superiorities of schools; processing, manufacturing, and technologies are the superiorities of industrial and mining enterprises. Cooperation between the two can shorten the research period and accelerate the transformation of results into direct productive forces. For example, our school cooperated with the Jiangxi No 4 Factory in successfully developing the JY5D gyrocompass, which possesses the merits of being compact in structure, pleasing in appearance, advanced in technical norms, stable and reliable in working, having a long gyro service life, and conforming to international standards. Of the made-in-China compasses, it is now the compass that is smallest in bulk, lightest in weight, and most economical in electricity consumption. It is suitable for use on large, medium-sized, and small ships and boats; it is the first compass for which the ship inspection department has issued a model license, and will change the situation in which for a long time our country had depended on imports for ship gyrocompasses. Our school, in cooperation with the Shanghai Bicycle Research Institute, has successfully developed the MC-81 low-melting point copper base welding alloy, which solved the longstanding, big, and difficut problems in bicycle front fork frame production of the salting-in immersion welding temperature being high, consumption of electricity being at a maximum, environmental pollution being serious, operational conditions being very bad, and product quality not being stable in grade, cuasing a one-third drop in electricity consumption.

In cooperation with the Shanghai Feile Electric Loudspeaker General Plant, ours was the first in China to develop successfully the loudspeaker (?magnetic (?body press compound shaping technology) [daoci ti guo ji fuhe chengxing gongyi 1418 4318 7555 6855/6753 2357 1788 0678 2052 1748 1562 5669], which reduces the original 11 working processes to 4, raises the original raw material utilization rate of 60-70 percent to 95-98 percent, raises the nonlevel rate of parts test surface from 0.2 to 0.1, causes the limit core smoothing rate to reach Δ 9 and raises the loudspeaker (?magnetic conduction density) to 9 percent, so that the great improvement in production efficiency and production quality yields notable economic results. To set up a large-scale electric circuit imitation, design CAD system, with a data bank as its center and

composed of subsystems, our school has signed contracts with the Shanghai No 5 Components Plant for cooperative research on 10 projects. To develop energy resource production so as to make petroleum reserves and output grow constantly, and based on the needs of extremely shallow sea prospecting at the Shengli Oilfield, our school has signed with the Shengli Oilfield an agreement (September 1982-December 1985) for the joint development of the "Shengli No 2," a new-type well drilling ship for extremely shallow seas. After the successful development of this well-drilling ship, which is able to crawl or rotate on beaches and in extremely shallow seas, it will become a new creation in China and abroad.

3. The school has set up with industrial and mining enterprises joint bodies for scientific research and production.

The school conducts research, designing, and experimentation, and the factory conducts processing and test-manufacture, and also provides the school with a certain amount of the research expenses; after a result is authenticated, the factory puts it into batch production, and the school deducts a percentage, according to a stipulated proportion, of the annual sales volume (or annual profit). By this means, the school can shorten the period for producing results and constantly raise the level of research, so that the result is quickly popularized and applied and increases the benefits to the school, and the factory can constantly and quickly replace products, improve the competitive ability of its products, and greatly increase its profits year after year. Two forms are specifically organized. One form is of the "alliance" type: the school constantly provides the research results and technologies, and makes suggestions for the development of products, the organization of products, and adminstration and management, but the right to make policy decisions mainly lies with the factory. For example, our school has made alliances with a wind machine factory, the Lianfeng Fiberglass Plant, and the Baiguan Electric Machine Factory, all in Zhejiang. The three factories, which employ a total of 400 persons, in 1982 had a total output value of 8.92 million yuan, turned over to the state a profit of 995,000 yuan, and the factories' net profit was 2,826,000 yuan. The wind machines and cooling towers produced in complete sets are at the leading level of the same trade in China. The cooling towers produced by the Lianfeng Fiberglass Plant are organized by the Ministry of Machine-Building Industry for batch export abroad. However, because the factories' degree of understanding the importance of science and technology is not the same, and their level of administration and management is not the same, the growth in their output value and profits are also not the same. This causes the scientific research and production joint bodies to develop a high-level form, namely, the second form of production of jointly run factories and companies that "make an organic whole." The school not only provides research results and technologies, but also sends out technical factory directors and achieves who hold concurrent posts, and on major questions of production technology and of administration and management, the factory and the school jointly study and made decisions; the school's proportion of percentage deduction of economic results is appropriately increased. For example, the jointly run factory formed this year by our school and the Lianfeng Fiberglass Plant in Zhejiang, in less than a year's time completed the seriation of low-noise, low-energy consuming cooling towers, and has developed successfully four kinds of new

cooling towers, which have been put into batch production and whose performance norms reach the advanced level of foreign products of the same kind. Our school is preparing within the next one or two years, based on requirements and possibilities, to vigorously develop this high-level form of scientific research and production joint bodies.

4. The school and production departments or enterprises jointly set up research organizations.

This is a new form of carrying out education, scientific research, and production jointly that breaks free from department ownership, and can make the development of science and technology combine far and near with the development of production and further coordinate in unity. For example, the Handicraft Industry Bureau of Shanghai Municipality, considering the fact that die technology is one of the keys to developing production, improving product competitive capacity, and expanding exports, and our school, considering the requirements of the Scientific and Technological Commission of Shanghai Municipality for setting up a die technology teaching and research base and for the development of this course of instruction, decided, relying on our school's scientific and technological personnel, to jointly set up the Shanghai Municipal Die Research Institute, which would be responsible for its own profits and losses. The Shanghai Handicrafts Industry Bureau invested 1.3 million yuan and provided a 1.3 million-yaun interest-free loan, and also built a die experimental factory, with leaders of the research institute running the factory, which initiated research work in cooperation with the research institute. The institute now has a total of 42 full- and part-time research personnel who are undertaking 32 research projects and undertaking the task of providing directed training for 40 die technology college students; the institute has run two short-term training classes in die technology, in which 97 persons took part, for the handicraft industry bureau and the No 1 Electromechanical Bureau. Only being set up for half a year, the institute has already displayed the characteristics of small investment, quick results, and large benefits, of close integration with economic development, and of internal motive power and vitality. The two sides decided after consultation that our school would provide the research personnel, instruments and equipment, and the places for research, while the general company would provide the engineers and technicians, and with our school would jointly set up a plastic alloys research office to jointly work hard to open up a new situation in our country's research and production of engineering plastics. In addition, our school and the Shanghai Plant Physiology Research Institute under the Chinese Academy of Sciences, on the basis of agreements for cooperation by the school and institute in teaching and scientific research, under the premise of the two side's willingness to maintain without charge the current jurisdiction over personnel and equipment, and with the cooperation of the two sides' relevant scientific and technological personnel, and instruments and equipment, have jointly set up at Jiaotong University the "Molecular Biology and Genetics Engineering Research Office."

Over the past several years, we have adopted many forms of action geared to economic construction and in the service of the economy, including: strengthening applied research; vigorously seeking scientific research topics from

production practice; breaking down the barriers between departments, regions, and trades, and putting into practice scientific research and production coalitions of different forms and at different strata; initiating comprehensive scientific and technological cooperaton with certain provinces and cities, and supporting interior and border area construction; and initiating technological services geared to society. The above introduction is only what we have learned by breaking down the barrier between departments, regions, and trades to put into practice many forms of scientific research and production coalitions. Our view is: the reform of the school's management system has promoted the integration of the school's scientific and technological work with economic construction; and scientific and technological work geared to economic construction has also promoted the school's initiation of scientific and technological work and the raising of its educational level. We think that in this integration we must both cause the school to obtain certain economic results and keep in mind the development of science and technology.

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NATIONAL DEVELOPMENTS

MORE SCIENTIFIC, TECHNOLOGICAL COOPERATION URGED

Tianjin KEXUEXUE YU KEXUE JISHU GUANLI [SCIENTIOLOGY AND MANAGEMENT OF SCIENCE AND TECHNOLOGY] in Chinese No 2, 12 Feb 84 pp 2-5

[Article by Qinghua University: "Extensively Develop Scientific and Technological Cooperation To Make a Greater Contribution to Developing the Economy"]

[Text] In the scientific and technical cooperation that Qinghua University has initiated in several dozens of cities and prefectures, it has adopted a variety of forms such as the turning over of research results, technical cooperation and services, the setting up by the university and factories of joint bodies for scientific research and production, technical advice, and technical training, and striking results have been obtained. The university's understanding gained from experience is that there must be: importance attached by the leadership and implementation of organization; importance attached to application and a striving for beneficial results; and voluntary participation and mutual benefit, and the signing of contracts. This article puts forward some problems and suggestions that need to be resolved for the further initiation of scientific and technical cooperation.

Qinghua University makes a point of displaying the role of a higher school as "both a center for education and a center for scientific research," widely initiates scientific and technical cooperation, and, while guaranteeing the training of talents and the completion of the state's key scientific research tasks, widely initiates outside the university scientific and technical cooperation of varied forms. In the fields of energy resources, materials, computers and their application, urban construction, biomedicine, and chemical engineering, every year it undertakes 50 topics in Beijing Municipality. It also has reached long-term comprehensive agreements for cooperation with Tianjin, Wuhan, Dandong, and Changzhou. With Nantong, Suzhou, Wuxi, and Xuzhou in Jiangsu Province, with Xiangfan and Shashi in Hubei Province, with Dalian, Yingkou, and Jinzhou in Liaoning Province, with Siping and Tonghua in Jilin Province, as well as with some prefectures in eastern Fujian, Hebei, Henan, Shanxi, Hunan, and Heilongjaing provinces, it has initiated many kinds of scientific and technical cooperation. The number of the above-mentioned items of scientific and technical cooperation of various types is a little over 300.

Success has been obtained in most of these items, and a number of them have already been directly used in industrial production and have obtained economic results. For example, in the scientific and research items undertaken for Beijing Municipality, every year more than 20 of them are awarded prizes for being outstanding scientific and technical results in the municipality. Among them, The "(? heat conversion network enhancing synthesis)" [huanre wangluo youhua zhonghe 2255 3583 4986 4820 0327 0553 4844 0678] is used in the oil refinereis of Beijing's Yanshan Petrochemical Company and the oil refineries of Shandong's Qilu Petrochemical Company, where it has raised the network transformation thermal efficiency respectively from 47.1 percent to 71.1 percent and from 66 percent to 80 percent, effecting a saving of 14,000 to 16,000 tons of fuel a year and a gain of more than 1 million yuan a year. The "(? new industrial technique of added salt extraction and preparation of anhydrous ethyl alcohol)" (jiayan cuiqu zhibei wushu yichun xin gongyi 0502 7770 5488 0648 0455 0271 2477 3055 0044 6815 2450 1562 5669], an alcohol which is an important new material in the production of Vitamin B, used by Tianjin's Xinxin Conditioning Plant, in the past was difficult to purchase abroad and its price was fairly high; now, with the use of this new industrial technique, the price is half of that if it were purchased abroad, and the annual income has increased by more than 1.2 million yuan, a development which has been deeply welcomed by factories.

Forms of Cooperation

Our scientific and technical cooperation can be summed up, on the whole, in five types.

1. Handover of results. The scientific research results of the school are handed over or turned over for production to the production departments. The school provides comparatively mature scientific and technical data, conducts the necessary training, and helps the factories to master the key techniques, so that the results of scientific research results are directly turned into productive forces and give rise to economic results. For example, the first advanced technology exported by our school abroad--the QH-ARC electric arc welding control method and its power source, which is up to the international advanced level--is being used in the Tianjin Welding Machine Plant. In the "titanium plate drawing technique," which is praised as a "lively combination of traditional handicraft with science and technology," no pigments are used, but instead an electric pen draws on a titanium plate rich, brightly colored, beautiful landscape pictures, animal pictures, and design pictures that are used for ornaments, new products of industrial technology, and building decorations. The technique has been handed over to the Wuhan City Handicrafts and Fine Arts Company.

2. Technical Cooperation and Services. The school accepts the task of conducting research on new productions entrusted to it by factories; or develops and supplies key equipment to help in the technical transformation of factories; or helps the factories to test and analyze equipment; or utilizes the theoretical, test conditions, and academic superiorities in the school to obtain new test results, and afterward, in cooperation with the production departments, to

carry out intermediate tests or industrial-type tests at the industrial sites to obtain integrated technical results, which are then formally put into production; and so forth. The "hollow cathode electric discharge ion plating technique," which the school was entrusted by Dandong City to develop, was a new technique rapidly developed in the seventies. It is used by the Dandong Watch Factory for the plating of its watch cases, and it possesses the characteristics of having a color that is pleasing to the eye, a smooth finish that is beautiful, as well as basically combining firmness, wear- and damage-resistance, and corrosion resistance. It has been deeply welcomed by the production units and the consumers, and has added to the watch's extraordinary splendor.

3. The school and factories combine to form a joint body for scientific research and production. High-level researchers sent from our school and beginning- and intermediate-level researchers assigned by the production departments jointly form research groups. With priority given to technological guidance, the school does research work in the production departments, which after becoming successful is used by production units in their production. There are now three joint bodies: One is the "Jinghua Electrical Equipment Company," formed by our school's Electrical Engineering Department and Beijing's Tongxian County Micro-Electrical Machinery Plant. The plant and the school, each displaying their own superiorities, have already completed 12 new technical results (in the year before the establishment of the joint body there were only 2 new technical results), and the profit and gross output value have respectively increased by 32.3 percent and 21.3 percent over those of the year before. Among them, the successfully developed "electric machine energy-saving electric fan cover" is adaptable to be fitted on 55-kw electric machines; each one costs 120 yuan, and its performance is good, it is convenient to use, and it saves a remarkable amount of energy. Beijing Municipality has decided to popularize it throughout the municipality, and it estimates that it will save 10 million kwh annually. The State Economic Commission has also held a conference to popularize it throughout the country. The second joint body is the "Jinzhous-Qinghua Electronic Computer Company," which was established in the middle of May by our school's computer engineering and science department in cooperation with Liaoning's Jinzhou Electronic Computer Plant. There is also the "Eastern Fujian-Qinghua Technical Cooperation Company," which was set up by our school's nuclear energy research institute in cooperation with eastern Fujian, with the main task of conducting research on ion plating techniques and application. Contracts have been signed, and preparations are being made to start business.

4. Technical consultation. Either at invitation or behest, the teachers of our school are providing consultation services to some city governments in the form of providing technical consultation or making technical suggestions, and the consultation is comprehensive and directed; there is consultation for a system or a trade, for example on a city's building plans, instruments and apparatuses; consultation for a factory and a specific production enterprise; and so forth. There has been a fairly big development of this kind of cooperation in recent years.

5. Technical training. There are two situations in this regard: one is the popularization of the application of technologies that are handed over and the results of scientific research, the conducting of training of a special-topic nature or the running of training classes that provide concentrated training, for example in the 10 to 19 small chemical fertilizer special-purpose wind machines, rustproof steel coloring, and new-type alloy filling yarn tubes; and the other is training that gives priority to special topics, for example, in energy-saving techniques, microcomputer application techniques, and radiation techniques. Running training classes or popularization and application classes, which provide concentrated training, is an effective way that achieves comparatively greater, faster, better, and more economical results. In the summer vacations of last year and this year training classes were conducted on the "new-type alloy filling yarn tubes," which focused on the specific properties, mechansim, production, and utilization of "new-type alloy filling yarn tubes," and in which theory and reality were closely integrated. The classes received unanimously favorable comments from the relevant units, and made a positive contribution to promoting the use of new techniques in our country's textile industry and to achieving "the substitution of plastic for wood."

Several Points To Understand

In initiating scientific and technological cooperation, on the whole there are the following common points for fast progress and marked results:

1. Importance attached by leadership, organization of implementation.

Having local leaders with foresight and sagacity who attach importance to science and technology and to talent and who directly engage in scientific and technological cooperaton is the key to good cooperation between city and school. Wu Guanzheng [0702 1351 2973] who graduated from our school in 1965, had not been mayor of Wuhan long before he, with the support of the leading comrades of the city's party committee, took the initiative to invite the school's leaders to come to Wuhan City and make an investigation, and city-school scientific and technological cooperation agreements were then signed. The leading comrades of other cities, like Dandong, Changzhou, Siping, Tonghua, Xiangfan, and Jinzhou, earnestly and sincerely respect knowledge and intellectuals, and have specifically and thoroughly studied and implemented projects to solve problems and contradictions that have appeared, thereby vigorously promoting the initiation of scientific and technological cooperation.

At the same time, the organization of implementation and the unblocking of channels have provided conditions for scientific and technological cooperation. With the deputy mayor at the head, Beijing Municipality has organized institutions of higher learning and scientific research units to set up the "Beijing Municipal Scientific and Technological Cooperaton Center"; in Tianjin there is a scientific and technological office directly under the leadership of the municipal government; the Scientific and Technological Commission and the Economic Commission of Wuhan City has specially assigned persons to check up on the implementation of relevant projects at administrative meetings; and Changzhou City has set up a foreign scientific and technological cooperation

service company, which has linked up with several dozens of units for cooperation in the form of "arranging a match" and which plays a positive role in linking up with the urgent needs of production departments and displaying the superiorities of research departments, effectively changing the past phenomenon in which there was no channel through which to popularize the results of scientific research and they were pigeonholed, and in which there was no place where the production departments could turn for help on difficult problems.

2. Attaching importance to application and striving for results.

The fundamental plan wherein the vitality of scientific and technological cooperation lies is the important principle of "making economic results the center" during the conscientious implementation of industrial production, and through scientific and technological cooperation attaining the result of improving quality, expanding output, lowering costs, and increasing income. If we are unable to effectively solve the actual problems in production, are unable to get economic results as fast as possible, there cannot be established a sense of confidence between city and school (factory and school) and also there cannot be exuberant vitality in scientific and technological cooperation. Therefore, schools must attach importance to applied technology, must strive for economic results, and must organically integrate the advanced nature of technology and the rationality of economics in carrying out the necessary comparative analysis of function and price. In recent years, a number of our school's results of scientific research have been welcomed and favorably commented upon by the relevant units--for example: (? salt-added extraction rectified preparation anhydrous ethyl alcohol) [jiayan cuiqu jingliu zhibei wushui yi chun 0502 7770 5488 0648 4737 5130 0405 0271 3541 3055 0044 6815], the (? No 12 steel rubber die) [12 hau gang xiangjiao muju 5714 6921 2895 5231 2875 0367], the QH-ARC new-type welding ceramic cutting tool) [dianyuan, fuhe danhua gui taoci daoju 7193 3293 1788 0678 8644 0553 8944 7118 3911 0430 0367]--because they met the above-mentioned demands. When these items were selected as research topics, close attetion was paid to the pressing needs of economic construction; when they were completed, as much as possible they were matured technically and transferred into production simply and conveniently, and they produced the desired result fast.

In attaching importance to application and striving for results, with regard to the work of schools, the relationships between teaching and scientific research, between branches of learning and tasks, must certainly be handled well. Training people is a school's original task, and key scientific research projects are assigned by the state. They both must be supported. If the relationships are handled improperly, it is possible that the phenomenon of cooperation tasks butting against key scientific research will occur. This wold adversely affect the school's normal order, and there would be a deviation from the correct practice of recent years summed up in the "one fundamental (training people), two centers (teaching center and scientific research center), and three-way combination (teaching, scientific research, and production)."

3. Voluntarily participating and mutually benefitting, signing of contracts.

Signing contracts on the basis of full understanding, voluntary participation, and mutual benefit, is an effective way of initiating scientific and technological cooperation.

Even a unit that has comprehensive cooperation between city and school, after the leadership departments have "dredged" channels, must exchange opinions with bureaus, companies, and factories, and for a certain project reach initial agreement or sign written proposals, and then, after further concrete deliberations by the factory and the teaching research section, sign a formal contract in which the obligations, responsibilities, technical norms, completion date, costs, as well as jurisdiction over the results are clearly set out in written form for the two sides.

The advantage of doing things in this way are: First, it is advantageous for initiating scientific and technical cooperation in a down-to-earth manner. Scientific and technological cooperation is a good thing and also a new thing. But this cooperation requires certain conditions, and there must not be a headlong rush into action or enthusiasm in form but no stress on actual results. For example, with regard to the popularization of a result, the school must look at the conditions obtaining in the other side, mainly two conditions: first, the situation--whether the leading group is sound or not, whether the production order is normal or not; and second, the technical condition--whether there are technical forces or not, and if the technical forces are temporarily inadequate, whether importance is attached to technology or not. Similarly, the factory must look at the conditions obtaining in the school, seeing whether the result is mature or not, what the market forecast is, how much investment there will be after it is put into production, the profit situation, and so forth. Second, it is advantageous for establishing credit and long-term cooperation. Agreement in principle between leaders cannot take the place of a contract on the basic level for a specific item, and an administrative order cannot replace genuine credit during the process of cooperation. In comparing agreements by leaders and agreements at the basic level, we need to pay more attention to the signing of contracts for items at the basic level. To this day we and Changzhou City do not have a written agreement, but through mutual visits by the leaders understanding has been deepened, and, in the future on the basis of completing such projects as the analysis and computation of the internal workings of tape recorders and the measurement of the oscillation of electric fans, our cooperative relations will be expanded. For example, after completion of the first part of the agreement on analyzing and computing the internal workings of tape recorders, a second agreement will be signed, and on the completion of the new project the relations between the two sides will become closer and closer. Third, it is advantageous for proceeding from reality and reducing the number of contradictions. In brief, in the cooperation we certainly must insist on: voluntary participation and mutual benefit, satisfaction by the two sides, and signing of contracts; if conditions are unsuitable and contradictions exist, it is unnecessary to improvise.

Problems and Suggestions

Scientific and technological cooperation is a new thing developed in the past several years, and unavoidably there will appear contradictions and problems.

1. Further heighten the understanding of the policies that "science and technology are productive forces" and that "the vigorous development of the economy must depend on the progress of science and technology, and science and technology must be geared to the needs of economic construction."

In the cooperation it has been discovered that the understanding of these policies is very unbalanced. The leaders of the Tongxian Micro-Electric Machinery plant have foresight, are courageous and resourceful, are enthusiastic, and have a positive attitude. They are attracting scientific and technical workers who are willing to go all out to make more contributions. Some leaders are used to the "gratuitous use" of scientific and technological results, and are somewhat out of their element when it comes to trying out and taking over the results. Some leaders lack the proper respect for the creative labor of scientific researchers, and they provide a small amount of funds for this work. When participating in a certain job of processing or an experiement, they say the results are "owned jointly," "classified," and even "the sole property of one factory." These things obviously dampen the enthusiasm of scientific researchers and are detrimental to the initiation of scientific and technological cooperation.

The solution to this problem of understanding needs to be carried out in practice. By strengthening propaganda and education, conscientiously summing up experiences, and constantly eliminating the influence of the "left," the different understandings in the end should be unified with the party's policies and with the joint making of more contributions to the construction of the four modernizations.

2. Adopt measures of encouragement, and promote by all ways and means the turning of science and technology as fast as possible into direct productive forces.

Formulation of the "technology handover law" and other relevant laws, which suit our country's actual circumstances and are advantageous for promoting the initiation of scientific and technological cooperation will change the current phenomena in which there are many loopholes in administration, rules vary, and there is even a lack of rules. It is an important measure for solving the problems that urgently need to be solved. The relevant documents and the speeches by the leadings comrades of the central authorities have many times clearly pointed out that there must be attempts to hand over technologies, but how this is to be done, the amount of expense, and the legal basis--in all these matters there are no laws to depend upon. Now, some units set the expense at 3 percent of the market rate, some set it at 1 to 5 percent, and others make it one to two times the cost--the standards differ and the means are varied, and a "negotiated price" can only be deterimined through discussion. Almost universally there is encountered the problem of the factory side insisting that there

"must be no handover to a second factory," which has a monopolistic implication, and this is an important cause of the many disparities that arise. There needs to be in law a clear distinction between "a single factory permit," "a single station permit," and "a common permit."

Attach importance to popularization, encourage popularization, and make popularization an important link to be grasped in turning science and technology into productive force. This year our school has established the special award for "outstanding results in popularizing and applying the results of Qinghua University's scientific research," issuing certificates of merit or money awards for scientific research projects that have produced good economic results in recent years, either leading to a profit of 1 million yuan or more, or leading to an output value of 10 million yuan or more, or after a result of scientific research has been turned into a formal product and the product has won the state's gold or silver medal. The reaction to this special award has been good, and it has promoted the popularization and application of the results of scientific research.

3. Conscientiously sum up the experiences of scientific research and production joint bodies, and encourage flexible and varied forms of joint bodies.

A scientific research and production joint body is a high-level form of scientific and technological cooperation and is a newborn thing. Several joint bodies have now appeared. For example, the "Beijing-Qinghua Electrical Equipment Company," formed by our school's Department of Electrical Engineering and the Tongxian County Micro-Electrical Machinery Plant, is successful and has made striking achievements in one year. Its prominent merit is that it has adopted a fixed organizational form, and with the posture of a master fully displayed the superiorities of the plant and the school, closely combining present and long-term development, and changing the cooperative relations of the two sides in the past into the joint relations of "members of one family."

An understanding now is that joint bodies should be varied, with long-term, fixed joint bodies and also short-term, loose federations of flexible patterns. Several fixed joint bodies which possess the necessary qualifications and in which the two sides are satisfied should be gripped solidly and their experiences constantly summed up.

4. Attach importance to research and application of "soft" sciences and "soft" technologies.

"Soft" sciences and "soft" technologies are an important part of scientific and technological cooperation. A currently existing problem is that the "hard" is valued and the "soft" is belittled, that is, for each specific new product, new piece of equipment, and new industrial art there is comparatively much attention paid, and people who want to talk about putting them into production seem to come to the school in an endless stream; but for "soft" sciences and "soft" technologies--such as feasibility studies for major projects, plan demonstration, strategic consultation with an industry or region, intellectual development, technical training, information and data, software systems, and management science--not enough attention is paid.

Just like the topics of the "hard" sciences, in the "soft" sciences data must be widely collected, synthesized and analyzed, and the necessary experimentation and research, data operations, and inductive comparisons made--there must be an expenditure of fairly arduous labor before one will be able to reach conclusions that are comparatively solid and have a definite scientific basis. Therefore, a high degree of attention must be paid to the important role of "soft" sciences and "soft" technologies, and proper support must be given to the leadership over "soft" sciences and "soft" technologies and to their manpower, funds, and projects.

(Duty editor Zhao Jian [6392 5329])

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NATIONAL DEVELOPMENTS

DEVELOPMENT OF CHINA'S COMPUTER SERVICES DISCUSSED

Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] in Chinese No 5, Sep 84 pp 65-67

[Article by Chen Liwei [7115 0500 3634], Computer Bureau, Ministry of Electronic Industry: "The Position and Role of Computer Services in the Computer Industry"]

[Text] The newly emerging computer services has attracted increasingly great attention from all walks of life. And how to accelerate China's computer industry is also a hot subject for discussion. Some views are given on the computer service as a promoter to the advancement of the computer industry.

Development of the Computer Industry Must Serve "Quadrupling"

Planning the development of China's computer industry in line with the great goal of the four modernizations as stipulated by the 12th CPC Congress is firm. The problem is how to carry this out on the basis of China's national circumstances. This requires checking and analyzing it in the totality of quadrupling the gross value of China's industrial and agricultural production by the end of the century.

Viewed in terms of China's production structure, the proportion of traditional production currently holds the dominant position. Even at the end of the century after the proportion of new production has greatly increased, the prportion of traditional production will still maintain a dominant position. For example, at present, the value of annual production of China's computer industry makes up about .1 percent of the gross value of the nation's industrial and agricultural production, and even after the annual value increased 40-fold by the end of the century, it will still make up 1 percent of the latter in the same period. Furthermore, taking the U.S. in the 1980's as an example, the value of annual production of the U.S. computer industry also is only 1.8 percent of U.S. GNP. This means that quadrupling the annual value of China's industrial production will rely mainly on growth in traditional production. In the light of China's present state, if traditional production does not adopt new technology, there will be no way for it to break free from its backward appearance, and the goal of quadrupling the gross value of annual industrial and agricultural production will come to naught. For the Chinese government to elevate the computer industry to the height of requiring vigorous and priority development, naturally has this import.

Thus, measures and plans for the development of the computer industry must obey and serve the Chinese economy and, in particular, the development of traditional production. This guiding ideology will not tolerate even the slightest deviation. The result of developing computers solely for the sake of developing computers in unthinkable. Of course, it should be noted that the development of the computer industry has its own special laws and conditions, but no matter what, it must place due emphasis on its own uniqueness.

This naturally leads to the following conclusion: for the computer as a product the product structure of computers must first of all be analyzed and development measures must proceed by relying on user needs.

The Structure of the Computer Industry Should Be Adapted to Its Product Structure

The structure of computer products can be divided into two classes horizontally and vertically. The horizontal product structure includes super, large, medium, mini, and micro computers, and since everyone knows this, we will not go into details. Here we will emphasize an exploration of its vertical structure.

For ease of analysis, we can imagine the following abstract model. That is, for the ultimate user, any computer should be able to satisfy the user's special demands, and resolve specially designated work or occupational problems. Therefore, such a computer not only should have complete hardware (including peripherals and interfaces) and software (including applications software), and should also provide the user with technical services such as consulting, training, and maintenance so that the computer can be used. In this article, a computer which is made up on the basis of this vertical structure will be called a "composite product." This feature of computers has definite significance for ordering of the structure of the computer industry, i.e., the structure of the computer industry should be adapted to its product structure.

According to this, we can divide the computer industry into two large branches: one is computer manufacturing and the other is computer services (also called information processing). Enterprises which design and manufacture computer hardware and complete systems belong to the former. The range of their activities is common knowledge; this is definitely something which would be further developed. However, this article is mainly about the problem of developing services.

The scope of the computer services business is very broad and generally can be divided into the following six categories:

(1) Specialized services. This includes providing the user with technical consultation and commissions from the user for system analysis and program design.

(2) Software development. Providing the user with general software products (software packages).

(3) System integration. Integrating purchased hardware and special interfaces for various kinds of equipment and the necessary software into a complete applications system (also called a turnkey system) and providing it to the end user.

(4) Data or information processing service. Providing users with computer time on one's own computers or carrying out data processing jobs on behalf of the user.

(5) Database (information supply) service. Providing economic and technical information to users.

(6) Other. Including technical training, equipment maintenance and data recording, etc.

On the basis of the situation in 1981, the proportions taken up by the computer manufacturing industry and the computer service industry within the computer industry in the U.S. was: gross computer industry sales were $47.622 billion, of which $25.525 billion, or 53.6 percent, was manufacturing and $22.010 billion, or 46.4 percent, was service; total employment in the computer industry was 745,000, of which335,000, or 45 percent, were in manufacturing and 410,000, or 55 percent, were in service. The two were roughly equal. However, the service industry is growing rapidly at a rate of 24 percent annually, and it is estimated that before long, its proportion will greatly surpass that of manufacturing.

In China, in view of the trends in the demands made on computer products by the four modernizations, the computer services industry might even take priority over computer manufacturing. For example, for a computer system project, everything, beginning with feasibility studies and preliminary preparations to implement it right up to writing applications software and post-production maintenance is within the scope of the computer service industry. And this cannot be done by relying on computer manufacturing alone. Some larger users with the necessary conditions can do all these service tasks on their own. But new users of large and small computers will emerge in large numbers and if they do not have the support of appropriate services, the computer industry will be hard put to develop smoothly.

The Development of Computer Manufacturing Relies on the Support of Computer Services

Since the 3d Plenary Session of the 11th party Central Committee, China's computer services have gradually received higher regard and strengthening. Computer service companies, software companies and systems integration companies or plants have been established one after another. But the pace of development is far from satisfying the needs of national economic development. Fewer than 10,000 of the present 80,000 employees of the computer industry are engaged in services. Some units and personnel which used to be engaged only in manufacturing have begun to take on some service tasks and this is very necessary. But frequently this is regarded as makeshift and is only temporary

or even viewed as a burden. Many users cannot get the help they should. And this is very disturbing.

It's difficult to imagine that without the support of services, manufacturing could make computers and their systems play the role they should. Services can develop independently of manufacturing, but it would be hard for manufacturing to move an inch without services. Without the support of services, there is no way for computers to enter new areas and be accepted by tens of thousands of users. Services are closest to the user and manufacturing can get from that extremely valuable information for use in planning the direction of product development. The labor or products provided by services can supplement the shortcomings of manufacturing's products to make them better suited to user needs and lengthen appropriately the life of manufacturing's products and improve their tolerability.

The conclusion that is drawn from this is: the more we wish to develop computer manufacturing, the more we should develop computer services.

My Views on Measures for Development of Computer Services

Computer services have very different characteristics from computer manufacturing.

(1) The products or services which they provide the user depend primarily on intellectual labor, most of the people engaged in this field are technicians. Thus, the degree of intellectual development will be a conditioning factor in developing services.

(2) Since service type projects are very numerous, in terms of scale, they are mostly small scale, even four or five people can start a business, it is very adaptable and flexible and the risks are generally very small. The managerial methods and systems may be varied and numerous, with national, collective, and individual all having room to maneuver.

(3) Regionally, they are decentralized. Services must get as close to the user as possible. Excessive centralization is not favorable for this work. Regions or cities could and should get involved simultaneously.

(4) It is specialized services. Services which specialize in software products and system integration are especially so. This is because they must be well versed in the fields demanded by the user. It is very difficult to make a service department know intimately different businesses nor is it necessary.

China's manpower resources are abundant, people's ability at logical thinking is strong, labor costs are low, and not only is there enormous potential for developing computer services which succeeds through intelligence but under present circumstances where the hardware/performance cost ratio of Chinese manufactured computers is in an inferior position internationally, developing the superiority of services very possible could roll back the performance cost ratio of the ultimate "composite computer" and have domestically manufactured

computers enthusiastically welcomed by users for that reason. Clearly, this will be very advantageous for the development of the national economy.

According to incomplete statistics, there are about 60 computer services type units in China at present and there are about 10,000 personnel involved. This is very valuable. But this number is really too small. It is estimated that by the end of the century China will need several thousand such enterprises, and several hundred thousand personnel distributed about the country. In particular, in the past few years, there has been a sharp increase in the numbers of microcomputers and their functions are becoming more powerful. If there is a shortage of services support there will be no way to fully exploit these microcomputers. This should be given serious attention.

It is now urgent that we develop computer services in a variety of ways and forms to bring these problems to an early resolution and to greet the preparatory conditions of deeper and broader promotion of applications of computer products. This writer believes that:

1. National policy should play a guiding role. There should be policies and measures designed to support and encourage the development of computer services, for example, preferential treatment for investment, loans and taxes.

2. There should be legal guarantees, such as formulating laws to protect rights to software.

3. Adopt thorough and effective emergency measures, such as permitting enterprises which were to be primarily manufacturing to immediately strengthen technical service departments or even covert to services.

4. Encouraging institutions of higher education and scientific research departments (not just those specializing in computers) with the necessary conditions to actively develop computer services or train technical service personnel for the local area and even help them to establish collective or individual service enterprises.

In addition, viewed from the perspective of the compound nature of computers and the urgency of user demand, work to make computer products domestic production currently should begin with those parts which are within the scope of services and be intensified. For example, putting Chinese characters on imported computers, translating and publishing user documentation for imported computers, and personnel training and equipment maintenance. Without this work, what the user gets will be an incomplete product. This made-in-China-status is both something users want and also can cultivate and strengthen services, and it is a good thing which can double the results. Of course, hardware which comes from manufacturing also should have the made-in-China-status and should be stressed. Nevertheless, we cannot be lax or even overlook the manufacture of non-hardware parts in China and even less we should feel that the manufacturing of non-hardware part in China is purely censure of foreign factory and business service.

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NATIONAL DEVELOPMENTS

DEVELOPMENTS IN MICROELECTRONICS: PAST AND FUTURE

Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] in Chinese No 5, Sep 84 pp 61-65

[Article by Li Zhijian [2621 1807 1017], Qinghua University: "Developments in Microelectronics: Past and Future"]

[Excerpts] A brief review of the past evolution in microelectronics is followed by a discussion of its current developments and future trends seen as characteristic of the technology. Some suggestions are then offered as to the advancedment of microelectronics in China.

I. Brief Review of the Development of Microelectronic Technology

II. Characteristics and Development Trends in Microelectronic Technology

Currently, the important development directions of microelectronic technology as represented by VLSI are:

(1) The width of characteristic wire basically will continue to be thinned by the principle of down-scaling. In the early 1990's, the production level will be close to 1μm, and the research and development level will enter the submicron level. Because of this, direct silicon chip electron beam tracing technology and X exposure technology will replace or cooperate with projection optics copying technology; dry etching technology will further improve and be completely adopted; replacing polysilicon grids with high melting point metallic silified objects which are one magnitude or more lower than polysilicon resistors; using highly reliable aluminum alloys or multilayer metals to replace today's aluminum metalicizing; using sinoite grid dielectric film so as to reduce the thickness of the grid oxidized layer to about 100 angstroms; using the ion implantation doping of such new technologies as transient annealing to obtain highly concentrated shallow PN junctions less than 0.1μm, etc.

(2) Computer-assisted design programs of various VLSI computers will gradually be combined to form one database management CAD system and from CAD develop to wholly automated design and finally be combined with computer assisted manufacturing to realize the complete automation of integrated systems from design to production.

(3) The diameter of silicon chips used in production will increasingly become larger. In the 1980's they were 6-8 inches and in the 1990's they may grow to 10 inches. Control of the oxygen and carbon content of silicon chips and control of microdefects will continue to improve. New integrated components of GaAs substrate with many times more mobility than silicon will be put into use (GaAs 4K RAM with an access time of only 2.8 ns has already been developed; the MMIC 20GHz GaAs traveling wave wide-band amplifier chip has also been test manufactured). As the area of silicon chips becomes larger, processing technologies as high as 900°C will be supplanted by low temperature ion or laser assisted technologies.

(4) Microelectronic components and structures using new operating principles or modes will constantly appear and it will be possible to bring about another great leap in microelectronic system performance. According to this year's reports, the access time of GaAs 1K RAM using HEMT structure is only 2.8 ns, and this is only one example. With the reduction of wire diameter relative to the electron free path, when it is as small as the length of a deBroglie wave, the workers on the component physics of the microelectronic components will face a series of new challenges.

(5) Measurement (including research on measurability and measurement technology) of microelectronic integrated systems and reliability physics will develop rapidly.

(6) Production of commodities will gradually develop from unicomputerized and computer assisted production to full automation.

(7) Three-dimensional technology based on SOI technology will experience great developments in the nineties and may also produce some useable components.

Thus, we have reason to expect the following to occur:

(1) The degree of integration of integrated microelectronic components will continue to increase. Taking DRAM as an example, it will improve from 1 megabyte to 4 or 16 megabytes or even integrating large scale memories on a single silicon chip. The highest realtime level of a high speed circuit will be a stage delay time of about 100 ps, and the best stage delay time power consumption will be about 0.1 pJ, and later there will be an improvement of several magnitudes.

(2) With improvements in the degree of design automation, integrated circuits will move toward integrated systems. First of all, the proportion of user designed circuits will increase greatly and microelectronic products will spread to unprecedentedly broad applications areas.

(3) The performance/cost ratio of microelectronic systems will continue to improve greatly, the idea of electronic products as high level goods will change with it. In the process of even higher density integration, for normal electronic products, especially electronic products for daily use, low power consumption CMOS circuit technology will become superior.

(4) Microelectronic technology will promote the formation of a series of new technologies and new branches of science. For example, electronic mechanics and microstructuristics have already appeared.

Apart from the fact that it has the nurturing help of many fraternal sciences, the enormous demands of social progress, and the potential it carries within itself, microelectronic technology can develop so rapidly due to two characteristics worth emphasizing. One is that in the overall process of research, development, production, and application, the favorable cycle of research, development and production promoted by applications has revolved especially fast and the mutual feedback between technological and managerial information between links has been unusually prompt and effective; the supplementary relationships which have appeared in the developmental processes of integrated circuit technology and computer technology are sufficient to demonstrate this point. In addition, there is the high regard for talent with intelligence winning the victory. "Without Stanford, how could there be a Silicon Valley" is a very sensible comment on the experience of the electronics industry in the U.S. One main reason why Intel, Apple and many other small previously unheard-of specialized companies were able to achieve such worldwide reknowned development in risky capitalist competition in such a short time was by relying on talent which could constantly produce new results. On the other hand, some heavily funded major companies could not bring out competitive products and lost because of a shortage of talent.

These two features demonstrate this principle: formulating polices which make research, development, production and application realize a high speed favorable cycle and throughout are willing to spend money on development of intelligence have similar practical significances for developing China's microelectronics technology.

III. China's Microelectronic Technology

China's teaching and research on semi-conductor technology took its first steps after the state first formulated scientific development plans in 1956.

One of the urgent measures at the time was to concentrate the relevant faculty and students of the physics departments of Beijing, Fudan, Jilin, Nanjing, and Amoy Universities at Beijing University to complete a course of study related to semiconductors. At the same time, the Chinese Academy of Sciences established the Semiconductor Research Laboratory (later changed to the Institute of Semiconductors), the Second Machine Building Ministry made arrangements at the 12th Institute for a Semiconductor Research Laboratory (which later developed into the Institute for Special Research), and the Beijing Electron Tube Plant made arrangements for a semiconductor production shop. In this period, Qinghua University and other industrial and scientific schools began to arrange for majors in semiconductors. In this period, professional talent matured, especially, faculty and students trained jointly by the five universities, many of whom have become mainstays in China's microelectronics. In 1958-1959 China began to prepare germanium and silicon monocrystals and developed a germanium transistor which went into small batch production. It is worth pointing out that at the time germanium components still dominated

internationally and the development of silicon components was not long off, but China's concerned scholars could see this coming and put their major efforts into silicon and in the early 1960's manufactured silicon and metal and plane transistors.

This creative work laid the foundation for the development and production of medium and small scale and large scale integrated circuits which were based in silicon plane technology.

China's microelectronic technology has developed very rapidly after the 3d Plenary Session of the 11th party Central Committee with the development of such LSI circuits as 8080, 6800, and 8085 microprocessors, 4K/16K DRAM and 1K/4K SRAM, 1K ECL high speed dynamic memory and 16K PROM; we were able to provide the ultra-pure reagents, 3-4 inch silicon chips, and ultra-pure laboratory facilities required for small batch production; 3 inch assembly technology facilities which we developed ourselves have recently gone into production. After a certain period of adjustment, the semiconductor industry has begun to get on a comparatively rational track.

In basic research, such as deep energy level theory, high field domain, jiemian [0094 7240], and surface in semiconductor physics, CAD domain design and circuit analysis programs, carbon and oxygen action of silicon materials and microdefect control, unique contributions have been made. Some good achievements have been made in GaAs materials research, microwave integration, and photoelectric integration. The Electronics Society holds a national semiconductor integration technology and silicon materials conference ever 2 years, the national GaAs materials and microwave and photoelectric component conference, and the scholarly exchange conferences in surface, jiemian, and CAD all have given impetus to development of microelectronics science and the research and development of IS and LSI.

In summary, China's microelectronics technology and semiconductor industry in the developmental process of the last 28 years, in spite of undergoing the chaos of 10 straight years and the losses it caused, whether viewed from the angle of the foundation laid, existing scale and level achieved, or in comparison with other developing countries, the China's achievements and progress are clear and huge and should be admitted. However, compared with the advanced level internationally, the gap is not a very small one and if measures are not actively taken to formulate correct policies and measures, this gap will be in danger of continuing to grow larger. It is necessary to face it squarely.

Many comrades in China's industrial, scholarly, and educational circles have put forth many proposals to reduce this gap and bring the development of microelectronic technology into line with the development of China's economy and society. I am taking this opportunity as this essay is about to conclude to restate several supplementary opinions.

1. We should firmly believe that our efforts will continue to improve microelectronic technology and semiconductor industry, and we should have confidence

in the talent and intelligence of our own electronics technology workers. This is the basis for formulating programs and plans.

2. Doing a good job of promoting applications of microelectronic products not only is an important link in spurring on the development of microelectronic technology but also is a key to enlarging domestic markets. Formulating policies and measures which will give promoting applications adequate financial support and encourage scientific and technical workers to take the initiative to make contributions to open markets is an urgent task now and brooks no delay.

3. While thinking of ways to import internationally advanced technology, we should give sober consideration to the difficulty and limitations which can be imported and conscientiously consider the limitations we can absorb. We should have forceful measures to deal with bureaucratic error and waste of capital or missing opportunities.

4. Jointly capitalizing ventures and importing production lines should consider domestic markets and proceed from the national situation, first concentrating our forces in improving several key points, anticipating being able to break through to most urgently needed and most critical production technology faster to secure clear economic benefits. At the same time, existing technological forces should be comprehensively organized so that basic technology and development work which has breakthrough possibilities will develop by levels, in a measured and highly efficient fashion. The complementarity of these two aspects may make China's microelectronic technology secure greater development in just a few years.

5. Under China's present circumstances, placing more of our forces on developing user or semi-user designed circuits may be appropriate because for the time being there will not be a very big market domestically for such products as memories suitable for large scale production, and for now it is difficult to break into the international market. For this reason, establishing small scale design centers and individual silicon chip processing centers may be feasible.

6. Departments should not be restricted at any time from training talent in various ways or in not sticking to one pattern in using talent. At present in investing in industrial and technological development, increasing the portion used for training, providing relevant institutions of higher learning with appropriate instructional and experimental facilities, stressing practical continuing education for microelectronics personnel who are currently employed, formulating policies and measures beneficial to the flow of talent, we expect will bear fruit at an early date.

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NATIONAL DEVELOPMENTS

FUTURE PROSPECTS OF CHINA'S MICROWAVE SEMICONDUCTOR TECHNOLOGY

Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] in Chinese No 5, Sep 84 pp 86-92

[Article by Han Jihong [7281 4949 7703], Nanjing Sold State Devices Research Institute: "The Development and Future Prospects of Microwave Semiconductor Technology"]

[Excerpts] Brief Review

General Picture of the Present Level

1. Low noise amplification of small signals

2. Production and amplification of radio-frequency power

The X-wave band power FET transistor developed in 1982 by the Hebei Semiconductor can output 0.5 W at 10GHz and is already being used in some microwave electronic equipment. The Nanjing Solid State Component Institute has made a performance prototype of a full FET-ized 8GHz microwave communications repeater.

3. Duobei [1122 0223] sound interval ultrawide band amplification

4. Microwave applications

Three Development Emphases

The following three aspects are important directions for guiding indepth development of microwave semiconductor technology and they have vitality. Their effectiveness and impact will become increasingly clear in the late 1980's.

1. Microwave power synthesis technology

2. GaAs monolithic integrated circuit (GaASMMIC)

3. New type microwave semiconductor components

(1) High electron mobility transistors (HEMT)

(2) Permeable base transistors (PBT)

(3) Duishan [1417 2694] source field effect transistor (GST)

Prospects and Opinions

1. Such inherent limitations in solid-state technology as that the electron transport process is limited by the basic attributes of the materials' crystal lattice structure, the sensitivity of small-signal reception is limited by short noise and heat loss of volume resistance, and the power capacity of a component is limited by the thermal conduction performance of the solid-state medium and the fact that new materials and new breakthroughs in fine processing technology rely to a very great extent on new developments in electronics, optics, physics, metallurgy, chemistry, measurement, and precision machine manufacture are both barriers which restrict the development of microwave semiconductor technology. For the past more than 30 years, scientists and engineers have made many contributions to break through these barriers. Many topics are now being explored or attacked: utilizing external conditions such as electrical field, magnetic field, light, sound field, and ultralow temperature to change the dynamic state of solid-state matter electrons, artificially controlling crystal lattice structure and interface behavior to change the primitive behavior of solid state materials, searching for better behaving semiconductor and medium materials and ultrapure elements, especially new multielement chemical compound semiconductor materials, and developing higher resolution precision processing equipment and technological methods all to broaden frequency coverage, improve the sensitivity of microwave small signal reception and to increase the power capacity of communications, to fuse microwave semiconductor technology and ultra high-speed digital technology, optical integration technology, acoustical wave technology, and photoelectric technology into a new and broader generation solid-state electronic system. The third leap of microwave semiconductor technology must enter the history books by break throughs in these areas. This makes the prospects for more profound changes in electronic science and technology promising.

2. China is not too late in getting started in microwave semiconductor technology. The silicon sanduan [0005 4551] and liangduan [0357 4551] microwave components developed in the 1960's, the GaAs sanduan and liangduan microwave components and microwave hybrid integrated circuit developed in the seventies are already being employed in many domestically manufactured microwave electronic systems. However, in terms of level, it can be estimated that China's level of silicon and GaAs liangduan component, low noise GaAs FET and some microwave integrated circuits (MIC) is not far behind internationally, and the primary electrical performance of some of the results also is up to the level of similar world products. Yet many leading areas which should have the backup of advanced technology and basic research results and also demand the cooperation of many disciplines are clearly rather backward, especially a great deal of our work is still at the stage of imitation and basically we are without effective and innovative discoveries and inventions on our own nor have we developed major productive capacity. This is the major reason for the large gap in China's microwave semiconductor technology in such areas as within the range of broader frequencies applying small signal broadband, high power

production and signal control. If we do not make a series of concerted efforts it will be difficult to narrow this gap.

3. Developing hhina's microwave semiconductor technology must be to target the gaps and on the basis of China's national circumstances establish microwave development centers which combine in one entity scientific research and production, shift the attack from scientific research to production and further improve and organize the product structure required by industrial production. My views in the preceding sections on the esimate of the present state and what should be developed can be summarized as follows: Place development emphasis on the GaAs FET and its monolithic integration, and lay a good technological foundation with the goal of satisfying the major demands of domestic and national defense and economic construction; at the same time, aiming at the projects we want to develop, include key attacks on new materials and technologies and research on basic theory in the plan to avoid passive situations of urgent need but no preparations so that production, development, and advance research can be organically combined as prerequisites for being thorough about economic benefits and expect that by the year 2000 the gap with international advanced levels in some important areas can be reduced.

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APPLIED SCIENCES

COMPUTERIZED CHINESE CHARACTER PROCESSING VIEWED

Shenzhen SHENZHEN TEQU KEJI [SCIENCE AND TECHNOLOGY OF SHENZHEN SPECIAL ZONE] in Chinese No 4, 1984 pp 9-10

[Article by Chen Shengfan [7115 0524 0416], Director, Chinese Shenzhen Software Technology Company: "Trends in Chinese Character Process in Computer Systems"]

[Text] The first problem faced in extending computer systems which are widely used internationally into areas in China's national economy is how to expand the Chinese character functions of these systems, i.e., the problem of establishing a Chinese character system.

In the past few years there have been many breakthroughs in establishing Chinese character systems and much successful experience has been obtained.

From the late 1970's to about 1981, many people waxed enthusiastic about creating a Chinese character COBOL and a Chinese character BASIC. That is, to create a programming language in existing computer systems especially for processing Chinese characters. This method partially solved the problem of using Chinese characters in a computer system, but there were very great limitations, because the other programming languages in the system still could not process Chinese characters.

Beginning in 1982, some people tried to add a Chinese character function to the input/output management program in the operating system of a single-user microcomputer and had great success. This work was first done in the BIOS of the CP/M operating system, since the system call in the CP/M operating system was not yet revised, the programming languages in the operating system and the various utilities could process Chinese characters. Even such a utility program as DBASEII could be used for Chinese character processing essentially without change. In this way, Chinese character and alphanumeric processing were combined, the only difference being in the input method. If an alphanumeric keyboard is used to input Chinese character, it is necessary to use some type of encoding (such as telecommunications code, three-corner code, or phonetic-radical code). Thus, the table for the Chinese character input code to internal code (generally one Chinese character is expressed as two bytes) would have to be stored in the computer and loaded into the BIOS module.

Since programming languages and utility programs can be used for Chinese character processing without having to be altered, establishing software resources in this operating system could be of service to Chinese character processing. Therefore, adding a Chinese character function to the input/output management program of the operating system is a method which brings great profits for little investment.

Similar methods could be used not only on single-user microcomputers but also on multi-user computers. Some people added a Chinese character function to the input/output management program of the RSX-11M operating system of a PDP-11 and maintained the unity of Chinese characters and alphanumerics. Because the Chinese characters are processed as a character string, almost the entire resources of the operating system which were used for processing alphanumerics, can similarly be used to process Chinese characters. Similarly, some people also used this method with the UNIX operating system effectively.

Speaking theoretically, we do not treat Chinese characters as a new kind of data, but as a combination of alphanumerics so as to maintain compatibility with the original system. The method popular in Japan is different from ours. They are developing a JIS COBOL standard. The intention is to treat Chinese characters as a new type of data and add it to the COBOL language; adding a Chinese character processing function this way will make it impossible to be completely compatible with the original system. As our exchanges with scholars on Taiwan increase daily, the design thinking of Taiwan's Chinese character processing systems become closer and closer to ours.

However, establishing a Chinese character processing system which uses an altered operating system still has the following advantages:

1. There would be a better understanding of the different methods used by different operating systems and thus, of the operating systems. In addition, operating systems are constantly being added, and revising operating systems also an extremely difficult task.

2. For multi-user systems, making the character stock on the host computer: it takes 32 bytes to display one 16 x 15 matrix Chinese character on a screen. Particularly for long-distance communications, this is too inefficient.

A Chinese character terminal created by placing the conversion table of the Chinese character stock and the Chinese character encoding in internal code and emulating alphanumeric terminals (such as the VT100, ADM3, and IBM3278) which can display both Chinese characters and alphanumerics and is compatible in functions to the original terminal is called a connector compatible Chinese character terminal. With the aid of this connector compatible Chinese character terminal, in principle it is not necessary to revise the operating system's terminal management program to input and output Chinese characters. Since the character stock is located inside the terminal, generally the host computer need only output 2 bytes to be able to display a Chinese character. By being able to avoid the two defects discussed above, this connector compatible terminal is easy to use and easy to promote.

The connector compatible Chinese character terminal can be divided into synchronous and asynchronous types. The synchronous terminal requires a corresponding communications protocol. In addition, the cursor control character is not the same for different types of terminals. Therefore, in trial manufacturing connector compatible terminals, one should draw close to standard devices. Currently, most alphanumeric terminals use 25 lines of letters, thus the Chinese character terminal ought to have 25 lines of Chinese characters as well, in the interests of uniformity of Chinese characters and alphenumerics, and so as to use the alphanumeric full screen editing program for editing Chinese characters, too.

As far as printers are concerned, a Chinese character printer which printed out the Chinese character stock could be designed which when linked with various computer systems could spool output Chinese characters without revising the printer program in the operating system. Different alphanumeric printers use different control characters, thus when developing a connector compatible Chinese character printer, one should draw close to standard devices.

Since Chinese character terminals and Chinese character printers have just begun to be trial manufactured, it is urgent that a uniform device standard be established for cursor control and Chinese character printing control. If this is not done early, each plant will go its own way and subsequent uniformity will be difficult.

I believe that trial manufacturing a connector compatible Chinese character terminal and connector compatible Chinese character printer is a shortcut to adding a Chinese character processing function to existing computer systems. In this way, the original computer system's operating system, system software, and support software can be used for Chinese character processing. This is a more, faster, better, and cheaper path. Thus, a large amount of the system software, support software, and even some applications software (this is shared wealth of human brain labor) which is available internationally can be used for Chinese character processing and in the service of China's four modernizations. For just this reason, I think that computer systems which are widely used internationally, can also be very well used in various areas of China's national economy. I am very optimistic about these prospects.

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APPLIED SCIENCES

LASER APPLICATIONS IN CHEMICAL INDUSTRY DESCRIBED

Beijing XIANDAI HUAGONG [MODERN CHEMICAL ENGINEERING] in Chinese Vol 4, No 4 Aug 84 pp 21-23

[Article by Chen Daming [7115 6671 2494] of Fudan University: "Laser Applications in Chemical Industry"]

[Text] Laser technology is one of the success stories in modern science and technology. Since lasers have such outstanding features as good monochromaticity, high energy intensity and tunable frequencies, they have found widespread applications in industry, agriculture, medicine, military affairs and scientific research. Laser applications in the chemical industry have attracted broad attention. Researchers here and abroad have successfully applied the principles of laser chemical reactions to isotope separation, monitoring, purification and the induction of pyrolytic reactions and chain reactions. In this article we introduce mainly a few promising applications of lasers in the chemical industry and give a preliminary analysis on the characteristics of laser chemical reactions and their economic feasibility.

I. Application Examples

1. Producing chloroethylene with laser

Most chain reactions need high temperature, high pressure, or the presence of catalysts. If lasers are used to induce the chain reaction, the reaction may be carried out, at a lower temperature, avoid container wall effects, and reduce unnecessary secondary photochemical reactions.

Chloroethylene is an important raw material for producing polyvinyl chloride. The conventional production method calls for high temperature, high pressure and catalysis. Recently, scientists in West Germany have made important progress in the research of inducing chain reactions with a laser[1]. They have obtained a quantum yield of 10^4 by illuminating ethylene chloride with 308 nm wave length from a XeCl laser device. In other words, the reacting molecule after absorbing one photon can produce up to 10^4 product molecules. The chain reaction goes as follows:

$$CH_2ClCH_2Cl \xrightarrow{h\nu} CH_2ClCH_2\cdot + Cl\cdot$$
$$Cl\cdot + CH_2ClCH_2Cl \longrightarrow CH_2ClCHCl\cdot + HCl$$
$$CH_2ClCHCl\cdot \longrightarrow CH_2{=}CHCl + Cl\cdot$$

Experiments have shown that, under the conventional operating temperature of 500°C, the yield may be raised from 60 percent to 75 percent by illuminating the reacting system with a XeCl laser while the selectivity may still be maintained at 85 percent and the quantum yield is approaching 20,000. For reactions taking place below 350°C, laser illumination may increase the selectivity to 99.9 percent while maintaining the yield at 60 percent and the quantum yield at 5000. Figure 1 shows a comparison of the laser induced reaction and the thermal reaction. According to the report, they have produced several kilograms of chloroethylene with this method. They claim that the new method allows the reaction to proceed at a lower temperature and hence consumes less energy, it also improves the yield, eliminates undesirable byproducts and reduces environmental pollution. They are in the process of conducting larger scale experiments and plan to build a 1000-ton scale intermediate testing plant.

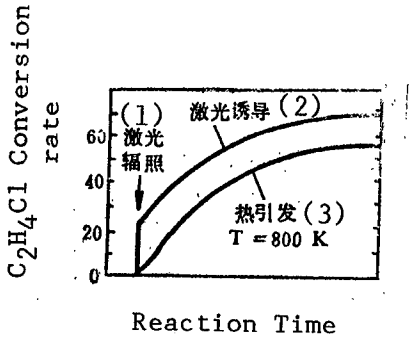

Fig. 1 Comparison of laser induced reaction and thermal reaction for producing chloroethylene

Key:

1. Laser illumination
2. Laser induced
3. Thermally induced

2. Producing acetylene with laser

The energy intensity after laser beam focusing is very high, especially the transient power in a pulsed laser. When the reacting chemicals are illuminated by such high laser energy, a high concentration of free radicals may be obtained. Naturally the laser frequency must resonate with the reacting molecules. Such laser photodissociation not only provides useful dynamic information about the free radicals but also opens up new possibilities in chemical synthesis.

Recently a joint effort of the Japan Fuji Gas Industries, Ltd. [?] and the Government Industrial Research Institute's Osaka Municipal Industrial Science and Technology Bureau has developed a technique for producing acetylene by illuminating gaseous hydrocarbons with laser. The production rate is increased by 10 fold and the product purity is also improved[2]. In this method a pulsed laser with an energy of above 5 Joules is used to illuminate methane gas, the gas situated at the focal spot of the laser (where the power may reach 10 kW) is instantaneously excited to the plasma state and the laser-induced chemical reaction turns methane into acetylene. Any type of pulsed laser will satisfy the requirements. In the experiment, a CO_2 laser (5 Joule, 1 Hertz pulses) is used to illuminate 100 ml of methane gas for 3 minutes and produced 80 ml of acetylene. The yield is 80-90 percent, one order of magnitude higher than the electron beam method. Using ethane, propane and butane as the raw material, the yield is still 30-50 percent higher than the electron beam method. In addition, the reaction is instantaneous, the actual production time is very short and the purity of the product is high. This Japanese company is currently studying the economic feasibility, electric power consumption and laser output problems and may build an experimental plant.

3. Producing isotope with laser

Since the physical and chemical properties of isotopes are very similar, their separation is often difficult. The advent of the laser opens a new frontier for isotope production. In 1974 it was found that the infrared multiphoton dissociation of SF_6 had very high isotope selectivity and since then lasers have been used successfully in the isotope separation of hydrogen, carbon, oxygen, boron, sulfur, uranium and other elements.

In recent years breakthroughs have been made in the industrial application of isotope separation by laser. In the Soviet Union the Kurchatov Atomic Energy Institute began exploring the separation of ^{13}C isotope in 1979 and has made small scale production[3]. They used the CF_3I system and a TEA CO_2 laser device (average output power of 1000 W and repetition rate of 200 Hz) and achieved a ^{13}C yield of 60 g/hr. Tests have shown that the multiphoton dissociation method is ideal for the separation of ^{13}C from the CF_3I system and the cost is several times lower than the commercial method.

In the area of uranium isotope separation by laser, Lawrence Livermore National Laboratory in the United States is in the forefront. They separated uranium isotopes with an atomic excimer laser, and recently they have also made major progress in the system testing of laser enrichment and are prepared to build an experimental facility 1/4 the size of a plant to further verify the characteristic parameters in an industrial production operation. According to estimates, a full size laser uranium isotope separation plant[4] may be put in operation by 1990. It has been claimed that the cost for producing nuclear fuel by the laser method is only 1/6 of the gas diffusion method currently being used.

4. Monitor chemical plants with laser

Lasers are superior sources of light and heat and have been widely used in analysis. So far lasers have been used in such analytic techniques as laser fluorescence spectroscopy, laser Raman spectroscopy, laser acousto-optic spectroscopy, and laser photoionization spectroscopy. Such methods are a great improvement over the sensitivity and resolution of conventional analytic methods. In the meantime, the good directionality and large propagation distance of lasers have also led to a new remote sensing analytic technology--the LIDAR--for the monitoring of atmospheric pollution.

Cramp et al.[5] in Great Britain first installed a LIDAR monitor system at the Winton Polyethylene Chemical Plant using two continuously tunable CO_2 lasers. It may scan the entire plant grounds and report the distribution of hazardous gas leaks by an electronic display system. The scanning monitoring system is installed on a high tower and the laser propagates through about 40 meters of air and scans the grounds of the chemical plant, see Figure 2. The monitor is connected to a computer for fast automatic scanning and display. The computer controls the video display of the ethylene concentration in the atmosphere above the plant and prints output messages. If necessary the computer may also trigger an alarm system or even "freeze" the incident. The two CO_2 lasers are tuned to different wavelengths, one is absorbed by ethylene and the other not absorbed. The two beams of light come out together and form a 1 meter diameter spot in a 100 meter perimeter. The laser power is lower than the natural radiation level of the human body and the ground and is therefore harmless. The content of the hazardous gas is given by the following equation:

$$CL = \frac{-\log \frac{S_1/P_1}{S_2/P_2}}{2(\lambda_1 - \lambda_2)}$$

where S_1 and S_2 are the reflected signals of the two lasers, P_1 and P_2 are the transmission power of the two lasers, and λ_1 and λ_2 are the wavelengths. CL stands for the gas concentration to be detected (in g/m^2 [?] or ppm).

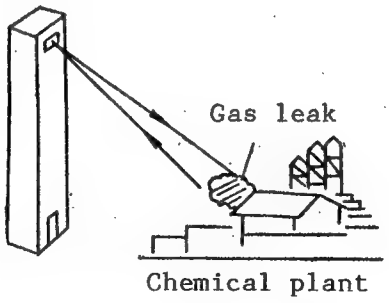

Fig. 2 Schematic diagram of the chemical plant laser scanning monitor system

II. Economic Analysis

From an economic viewpoint, it is much more expensive to use a laser in providing the energy needed in a chemical production process than the heating and pressurization method. This is true not only because of the high cost of laser devices but also because of the low energy conversion efficiency of lasers, generally in the 1~10 percent range. In other words, using 100 W of electric energy or photo-energy to excite a laser system produces only 1~10 percent of laser energy. The production cost of laser energy is estimated to be U.S. 1~100 dollars per megajoule which is several orders of magnitude higher than electrical or fossil energy. It is therefore natural to ask whether it makes economic sense to use such an expensive energy source for chemical production. The answer must come from the unique features of laser chemical reaction, product price and the demand by the society.

(1) High selectivity

The basic principle of laser chemical reaction is the selective excitation of the reacting molecules using the monochromatic nature of a laser and thus achieve the selective chemical reaction. The selection process may be divided into intermolecular selection and intramolecular selection. In the former process the laser only selectively excites certain molecules in a mixture to achieve a specific chemical reaction or to produce a specific product. The latter refers to the selective breaking of chemical bonds in a molecule to achieve a certain dissociation. Since the energy transfer is rapid, intramolecular selection is much more difficult than intermolecular selection.

Using the promising examples given above, the major reaction steps are summarized in Table 1.

Table 1 Major steps in laser chemical reactions

Example / Reaction steps	Isotope separation (Separate A from A')	Purification (Eliminate A from B)	Chain reaction (Obtain product B from A + B
Selective induction	$A \xrightarrow{h\nu} A^*$ $A' \not\longrightarrow$	$A \xrightarrow{h\nu} A^+$ or C $B \not\longrightarrow$	$A \xrightarrow{h\nu} C$ $B \not\longrightarrow$
Intermediate chemical reaction	$A^* \xrightarrow{h\nu} A^+ + e$	$A^* + B \longrightarrow D + E$ $C + B \xrightarrow{\text{or}} D + E$	$C + B \rightarrow \text{Product} + C$ (C regenerated)
Dissociation	Using electric field	Separating D+E from B using physical or chemical means	Collecting the product by physical or chemical means

As can be seen, high selectivity is a unique feature of lasers. For example, in the isotope separation of uranium using a laser, ^{235}U is selectively excited but ^{238}U is not. In the purification of silane, a laser is used to selectively dissociate a minute amount of impurity elements while the silane is unaffected.

(2) High quantum efficiency

The production costs of a laser-induced chain reaction may be reduced if a high quantum efficiency can be achieved. That is, a reacting molecule can produce a large number of product molecules by absorbing one photon. The production of chloroethylene using a laser is such an example.

(3) High cost products

Due to the high cost of the laser photon energy, economic benefits can be realized only by applying lasers to the production of high cost products or products in great demand. The production of ^{235}U nuclear fuel meets the requirement. The current method of producing nuclear fuel by gas diffusion suffers from a very low separation coefficient, elaborate plant facility, enormous energy consumption and therefore a high production cost.

In summary, the application of lasers in chemical engineering must be made selectively on appropriate systems. Due to the high costs, the chemical engineering applications of lasers have been slow. Estimates show that chemical products made by conventional methods generally cost less than $2/kg whereas the production cost using lasers is about $10/kg. However, laser method is a superior approach for reaction systems with a high selectivity and a high quantum yield and for new chemical products that cannot be produced with conventional methods.

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APPLIED SCIENCES

BOOLEAN PUBLIC KEY CRYPTOSYSTEM OF SECOND ORDER

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[Text] Abstract

A new type of public key cryptosystem--the Boolean public key system--was introduced in this paper. Furthermore, a special form of this system--the second order Boolean public key system--was investigated. It had the same authentic characteristics as the RSA system. It was believed that this system is a promising public key cryptosystem in terms of both security and execution speed.

I. Introduction

Public key cryptography is a new cryptosystem. It eliminates the limitation that the same key is required in coding and decoding in a conventional cryptosystem. When different keys are used in encoding and decoding, the encoding key (public key) can be made public without jeopardizing the security of the cryptosystem. Since Diffie et al introduced the public cryptography concept in 1976[1,2], several public key cryptosystems such as the RSA system by Rivest et al[4] and the trap door knapsack approach by Merkle et al[3] were published. A new class of public key cryptosystem--the Boolean public key system--was introduced on the basis of Boolean algebra in reference [5]. In this work, a simple Boolean public key system, the second order Boolean public key system, was investigated.

II. The Boolean Public Key System

Let us assume that $Z_{2,n}$ represents a set comprised of all the n sequence in $\{0,1\}$. If F is the transformation from $Z_{2,n}$, to $Z_{2,m}$, $\emptyset$ then F can be written as $F = (f_1,\ldots,f_m)$. f_i is an n-element Boolean function where i=1,...,m. In this form, F is called the Boolean transform from Z_2,n to Z_2,m.

If the Boolean transform G from Z_2,m to Z_2,n exists, for any $X \in Z_2,n$,

$$G \cdot F(X) = X$$

F is reversible and G is called the left inverse of F.

If $F_1,\ldots, F_k$ is a series of reversible Boolean transformation operators from Z_2,n to Z_2,m and $G_1,\ldots G_k$ are their respective left inverse operators, and if the left inverse G_i cannot be easily identified from F_i, then such a Boolean transformation with respect to (F_i,G_i), $i = 1,\ldots,k$, can form a public key cryptosystem. F_i can be the public key and G_i can be the secret key. Such a system is called a Boolean public key system.

In the following, we will study a special Boolean public key system, i.e., the Boolean public key Z_2,n to Z_2,n. If F is the Boolean transform from Z_2,n to Z_2,n with an existing inverse and G is the left inverse of F, then F is the one to one correspondence from Z_2,n to Z_2,n. Hence, for any arbitrary $X \in Z_2,n$, we get

$$G \cdot F(X) = X \text{ and } F \cdot G(X) = X$$

We called F the inverse of G, and G the inverse of F. Furthermore, one can see that the Boolean public key from Z_2,n to Z_2,n has the same "authentic" characteristics as the RSA system.

To study the Boolean public key, we must first study the Boolean transformation.

Let us assume that $f(x_1,\ldots,x_n)$ is a n-variable Boolean function and $||f||$ represents the number of medium and small terms in f or the standard formula. Moreover, let us assume

$$f^y = \begin{cases} f \text{ when } y = 1 \\ \overline{f} \text{ when } y = 0 \end{cases}$$

If $Y \in Z_2,n$, let $F^Y = f_1^{y_1} \cdots f_n^{y_n}$.

Lemma 1. If F is the Boolean transform from Z_2,n to Z_2,n, then necessary and sufficient condition for the reversibility of F is $||F^Y|| = 1$ for any $Y \in Z_2,n$.

Proof: For an arbitrary X, $Y \in Z_2,n$. The necessary and sufficient condition for $F(X)^Y = 1$ is $F(X) = Y$. If F is the Boolean transform from Z_2,n to Z_2,n, then the reversibility of F is equivalent to the one-to-one correspondence of F from Z_2,n to Z_2,n. Hence, the necessary and sufficient condition for F to have an inverse is $||F^Y|| = 1$ for an arbitrary $Y \in Z_2,n$.

Lemma 2

$$f_1 \oplus \cdots \oplus f_k = \sum_{\substack{a_1,\ldots,a_k \in (0,1) \\ a_1 \oplus \cdots \oplus a_k = 1}}^{\oplus} f_1^{a_1} \cdots f_k^{a_k}$$

Proof: The theory is proven to be valid when n = 1 by induction. Let us assume that the theory is valid when n = k-1, then

$$f_1\oplus\cdots\oplus f_K=(f_1\oplus\cdots\oplus f_{K-1})\oplus f_K=\sum_{\substack{a_1,\cdots,a_{K-1}\in\{0,1\}\\ a_1\oplus\cdots\oplus a_{K-1}=1}}^{\oplus} f_1^{a_1}\cdots f_{K-1}^{a_{K-1}}\oplus f_K$$

$$=\sum_{\substack{a_1,\cdots,a_{K-1}\in\{0,1\}\\ a_1\oplus\cdots\oplus a_{K-1}=1}}^{\oplus} f_1^{a_1}\cdots f_{K-1}^{a_{K-1}}f_K^0$$

$$\oplus\sum_{\substack{a_1,\cdots,a_{K-1}\in\{0,1\}\\ a_1\oplus\cdots\oplus a_{K-1}=0}}^{\oplus} f_1^{a_1}\cdots f_{K-1}^{a_{K-1}}f_K^1$$

$$=\sum_{\substack{a_1,\cdots,a_K\in\{0,1\}\\ a_1\oplus\cdots\oplus a_K=1}}^{\oplus} f_1^{a_1}\cdots f_K^{a_K}.$$

We can thus determine the validity of the theory of the reversible Boolean transformation from $Z_{2,n}$ to $Z_{2,n}$.

Theorem 1. When F is the Boolean transform from $Z_{2,n}$ to $Z_{2,n}$, the necessary and sufficient condition for the inverse of F to exist is that for any K different numbers $i_1,\ldots,i_K$ in $1,\ldots,n$ where $1\leqslant K\leqslant n$.

$$\|f_{i_1}\oplus\cdots\oplus f_{i_k}\|=2^{n-1}.$$

Proof. The necessity of the theorem is proved first. For any k different numbers, $i_1,\cdots,i_k$ where $1\leqslant K\leqslant n$, we get the following from Lemma 1 and Lemma 2.

$$\|f_{i_1}\oplus\cdots\oplus f_{i_K}\|=\sum_{\substack{a_1,\cdots,a_K\in\{0,1\}\\ a_1\oplus\cdots\oplus a_K=1}}\|f_{i_1}^{a_1}\cdots f_{i_K}^{a_K}\|=\sum_{\substack{1\leqslant i\leqslant K\\ i\ is\ odd}}C_K^i2^{n-K}=2^{n-1}$$

The sufficiency is proved next. Let us prove a conclusion first. When the theorem is valid, for any m different numbers $i_1,\quad i_m$ in $1,\cdots,n$ and any $a_1,\ \cdots,\ a_m\in\{0,\ 1\}$, $1\leqslant m\leqslant n$, we get

$$\|f_{i_1}^{a_1}\cdots f_{i_m}^{a_m}\|=2^{n-m}.$$

We will prove this conclusion by induction. When m = 1, the conclusion is valid from the theorem. Assuming it is valid when m = k-1 and not valid when m = k, then there are $i_1,\ \cdots,\ i_K\in\{1,\ \cdots,\ n\}$, $a_1,\ \cdots,a_K\in\{0,\ 1\}$, to make

$$\|f_{i_1}^{a_1}\cdots f_{i_K}^{a_K}\|>2^{n-K}$$

If $a_1\oplus\cdots\oplus a_K = 1$, then for any $b_1, \cdots, b_K\in\{0, 1\}$, as long as $b_1\oplus\cdots\oplus b_K = 1$ we get

$$\|f_{i_1}^{b_1}\cdots f_{i_K}^{b_K}\|>2^{n-K}$$

To generalize it, we can assume that $b_1=\bar{a}_1, \cdots, b_{2r}=\bar{a}_{2r}, b_{2r+1}=a_{2r+1}, \cdots, b_K=a_K$. Because

$$\|f_{i_1}^{a_1}\cdots f_{i_K}^{a_K}\|=\|f_{i_1}^{a_1}f_{i_1}^{a_1}\cdots f_{i_K}^{a_K}\|+\|f_{i_1}^{\bar{a}_1}\cdot f_{i_1}^{a_1}\cdots f_{i_K}^{a_K}\|=2^{n-K+1}$$

therefore

$$\|f_{i_1}^{\bar{a}_1}f_{i_1}^{a_1}\cdots f_{i_K}^{a_K}\|<2^{n-K}.$$

Also because

$$\|f_{i_1}^{\bar{a}_1}f_{i_1}^{a_1}\cdots f_{i_K}^{a_K}\|=\|f_{i_1}^{\bar{a}_1}f_{i_1}^{a_1}\cdots f_{i_K}^{a_K}\|+\|f_{i_1}^{\bar{a}_1}f_{i_1}^{\bar{a}_1}f_{i_1}^{a_1}\cdots f_{i_K}^{a_K}\|=2^{n-K+1}$$

therefore

$$\|f_{i_1}^{\bar{a}_1}f_{i_1}^{\bar{a}_1}f_{i_1}^{a_1}\cdots f_{i_K}^{a_K}\|>2^{n-K}.$$

In analogy, we can prove that when $b_1\oplus\cdots\oplus b_K=1$

$$\|f_{i_1}^{b_1}\cdots f_{i_K}^{b_K}\|>2^{n-K}.$$

From Lemma 2, we get

$$\|f_{i_1}\oplus\cdots\oplus f_{i_K}\|=\sum_{\substack{a_1,\cdots,a_K\in\{0,1\}\\ a_1\oplus\cdots\oplus a_K=1}}\|f_{i_1}^{a_1}\cdots f_{i_K}^{a_K}\|>2^{n-1}$$

It is contradictory to the theorem. Similarly, we can also prove that $\|f_{i_1}\oplus\cdots\oplus f_{i_K}\|<2^{n-1}$, when $a_1\oplus\cdots\oplus a_K = 0$ also contradicts the theorem. Therefore, the theorem is proven. When m = n, based on the proven conclusion, $\|F^{Y}\| = 1$ for an arbitrary $Y\in Z_2,n$. Furthermore, we know that the inverse of F exists from Lemma 1. Consequently, the theorem is proven to be sufficient.

Deduction 1. When F is the reversible Boolean transform from Z_2,n to Z_2,n, then for any $a_1, \cdots, a_n\in\{0,1\}$, when $a_1, \cdots a_n$ are not all zero we get

$$\|a_1f_1\oplus\cdots\oplus a_nf_n\|=2^{n-1}.$$

If we limit f to two operations $\cap$ (denoted as .) and $\oplus$, then f can be considered as an n-variable polynomial on GF(2). $F = (f_1, \cdots, f_n)$ is the Boolean transform form Z_2,n to Z_2,n. If there is a K and $1\leqslant K\leqslant n$, and the order of f_i is smaller or equal to K and $1\leqslant i\leqslant n$, then F can be called the Boolean transform

of the Kth order from Z_2,n to Z_2,n. The Boolean public key used for the Kth order Boolean transformation is called the Kth order Boolean public key. If the set of all the Kth Boolean public keys from Z_2,n to Z_2,n is expressed as $\mathfrak{B}[K]$, we have the following theorem.

Theorem 2. $\mathfrak{B}[1]\subset\mathfrak{B}[2]\subset\cdots\subset\mathfrak{B}[n-1]=\mathfrak{B}[n]$.

Proof. According to the above definition, it is obvious that

$$\mathfrak{B}[1]\subseteq\mathfrak{B}[2]\subseteq\cdots\subseteq\mathfrak{B}[n-1]\subseteq\mathfrak{B}[n].$$

Let's assume that $F=(f_1, \cdots, f_n)$ is the Boolean transform from Z_2,n to Z_2,n where $f_i=x_i$, $i=1, \cdots, n-1$

$$f_n=x_n\oplus x_1x_2\cdots x_K,\ 2\leqslant K\leqslant n-1.$$

Apparently the inverse of F exists. Furthermore, F is a Kth order Boolean transform.

If $x_n\oplus x_1x_2\cdots x_K\equiv h(x_1, \cdots, x_n)$, where h is a (K-1)th order Boolean function, then

$$x_1\cdots x_K\equiv x_n\oplus h(x_1, \cdots, x_n)=h'(x_1, \cdots, x_n)$$

Then, there is $a_{K+1}, \cdots, a_n\in\{0, 1\}$, which makes

$$x_1\cdots x_K\equiv h'(x_1, \cdots, x_K, a_{K+1}, \cdots, a_n)$$

$$\equiv h''(x_1, \cdots, x_K)$$

h" is still of the (K-1)th order, h" can be considered as a K-variable Boolean function. Because $h''\not\equiv 0$, therefore

$$|h''(x_1, \cdots, x_K)|\geqslant 2$$

Because $|x_1\cdots x_K| = 1$, we get

$$x_n\oplus x_1\cdots x_K\not\equiv h(x_1, \cdots, x_n)$$

Consequently, F is a Kth order Boolean transform instead of a (K-1)th order one. Hence, we can derive the following

$$\mathfrak{B}[1]\subset\mathfrak{B}[2]\subset\cdots\subset\mathfrak{B}[n-1].$$

If F is a nth order Boolean transform, from Theorem 1 the existence of an inverse for F can assure $\|f_i\| = 2^{n-1}$ for $1\leqslant i\leqslant n$. We can easily convert each f_i to the (n-1)th order using an appropriate pair matching method. Hence, we get $\mathfrak{B}[n-1]=\mathfrak{B}[n]$.

III. Boolean Public Key of the Second Order

Assuming F is the Boolean transform from Z_2,n to Z_2,n with an existing inverse then F can be used as a Boolean public key. When the known content is $X \in Z_2,n$, we can obtain the coded content $Y = F(X)$. However, when the secret key G is not known, decoding the coded document Y to obtain the original text is equivalent to solving the following set of equations:

$$\begin{cases} f_1(x_1, \cdots, x_n) = y_1 \\ \vdots \\ f_n(x_1, \cdots, x_n) = y_n \end{cases}$$

Theorem 3. Whether a n-variable second order equation set in GF(2) has a solution is a complete NP problem.

Proof. Obviously, the determination of a solution to an n-variable second order equation set in GF(2) is a NP problem. Next, we know that it is a NP completion problem, i.e., to determine whether

$$(x_{i_1}^{a_1} \cup x_{i_2}^{a_2} \cup x_{i_3}^{a_3}) \cap \cdots \cap (x_{i_{3r-2}}^{a_{3r-2}} \cup x_{i_{3r-1}}^{a_{3r-1}} \cup x_{i_{3r}}^{a_{3r}}) = 1$$
$$a_j \in \{0, 1\},\ i_j \in \{1, \cdots, n\},\ 1 \leqslant j \leqslant 3r$$

has a solution. Because

$$x_1 \cup x_2 \cup x_3 = x_1 \oplus \bar{x}_1 x_2 \oplus \bar{x}_1 \bar{x}_2 x_3$$

Theorem 3 can be converted into the determination of the solution to the following set of second order Boolean equations in GF(2):

$$\begin{cases} x_{i_1}^{a_1} \oplus x_{i_1}^{\bar{a}_1} x_{i_2}^{a_2} \oplus x_{i_1}^{a_1} x_{n+1} = 1 \\ x_{n+1} \oplus x_{i_2}^{\bar{a}_2} x_{i_3}^{a_3} = 0 \\ \vdots \\ x_{i_{3r-2}}^{a_{3r-2}} \oplus x_{i_{3r-2}}^{\bar{a}_{3r-2}} x_{i_{3r-1}}^{a_{3r-1}} \oplus x_{i_{3r-2}}^{\bar{a}_{3r-2}} x_{n+r} = 1 \\ x_{n+r} \oplus x_{i_{3r-1}}^{\bar{a}_{3r-1}} x_{i_{3r}}^{a_{3r}} = 0 \end{cases}$$

Because whether Theorem 3 is satisfied can be converted to the determination of a solution to a second order equation set on GF(2) by way of a time polynomial, therefore, it is proven that whether a solution to a series of second order equations in GF(2) exists is a complete NP problem.

For a series of second order equations in GF(2), although the solution determination problem is different from the solution finding problem, yet they are closely related. Just as the trap door knapsack problem, we can understand the difficulty in solution finding from that in solution determination. Hence, it is a very difficult problem to solve the document X from the code Y when the secret key G is not known.

Assuming A is a nxn non-singular matrix in GF(2), then the Boolean transform from $Z_{2,n}$ to $Z_{2,n}$ $F=(f_1,\cdots, f_n)$

$$f_i=\sum_{j=1\sim n}^{\oplus} a_{ij}x_j$$

is called a linear Boolean transformation using A as the transformation matrix. If A^{-1} is the inverse of A, then the linear Boolean transformation G using A^{-1} as the transformation matrix is the reverse transformation of F.

Theorem 4. If A and B are the linear Boolean transform from $Z_{2,n}$ to $Z_{2,n}$ and F is the Kth order Boolean transform from $Z_{2,n}$ to $Z_{2,n}$, then A.F.B is still a Kth order Boolean transfer from $Z_{2,n}$ to $Z_{2,n}$.

Proof. If $h_1, h_2,\cdots,h_{n-1}$ are the n-1, n-2,$\cdots$,1 variable second order Boolean function, respectively, then the Boolean transform from $Z_{2,n}$ to $Z_{2,n}$ is F = $(f_1,\cdots, f_n)$, where

$$\begin{aligned} f_1&=x_1\oplus h_1(x_2,\cdots,x_n)\\ f_2&=x_2\oplus h_2(x_3,\cdots,x_n)\\ &\vdots\\ f_{n-1}&=x_{n-1}\oplus h_{n-1}(x_n)\\ f_n&=x_n \end{aligned}$$

F is the Boolean transform from $Z_{2,n}$ to $Z_{2,n}$ with an inverse. The reverse transformation of F is G:

$$G=G_1\cdot G_2\cdots G_{n-1},$$

where $G_i=(x_1,\cdots,x_{i-1}, x_i\oplus h_i(x_{i+1},\cdots,x_n),x_{i+1},\cdots,x_n)$.

If A and B are the linear Boolean transforms from $Z_{2,n}$ to $Z_{2,n}$, then A^{-1} and B^{-1} are their respective transforms. From Theorem 3 we know that $A\cdot F\cdot B$ is also a second order Boolean transform from $Z_{2,n}$ to $Z_{2,n}$. Furthermore, its inverse is $B^{-1}\cdot G\cdot A^{-1}$. For this F, we may create a second order Boolean public key by choosing different A and B.

For example, when n = 6, we choose

$$A=\begin{pmatrix} 0&1&1&0&0&1\\ 1&0&0&1&0&0\\ 0&1&0&0&1&0\\ 1&0&1&0&1&0\\ 0&1&0&1&1&0\\ 1&1&0&0&0&1 \end{pmatrix} \quad A^{-1}=\begin{pmatrix} 0&1&1&0&1&0\\ 1&0&1&1&0&1\\ 1&1&1&0&1&1\\ 0&0&1&0&1&0\\ 1&0&0&1&0&1\\ 1&1&0&1&1&0 \end{pmatrix}$$

$$B=\begin{pmatrix}1&1&0&0&0&0\\0&1&1&0&0&0\\0&0&1&1&0&0\\0&0&0&1&1&0\\0&0&0&0&1&1\\1&1&0&0&0&1\end{pmatrix}\quad B^{-1}=\begin{pmatrix}0&1&1&1&1&1\\1&1&1&1&1&1\\1&0&1&1&1&1\\1&0&0&1&1&1\\1&0&0&0&1&1\\1&0&0&0&0&1\end{pmatrix}$$

$$F=(f_1,\ f_2,\cdots,f_6)$$

$$f_1=x_1\oplus(x_2\bar{x}_3\ominus x_2x_4\oplus x_3\bar{x}_5\oplus\bar{x}_4x_6)$$

$$f_2=x_2\oplus(x_3x_4\oplus x_3x_5\oplus x_4x_6)$$

$$f_3=x_3\oplus(\bar{x}_4x_5\oplus x_5x_6)$$

$$f_4=x_4\oplus x_5\bar{x}_6$$

$$f_5=x_5\oplus\bar{x}_6$$

$$f_6=x_6$$

$$P=A\cdot F\cdot B,\ P=(p_1,\cdots,p_6)$$

$$P_1=x_1\bar{x}_6\oplus x_3\bar{x}_4\oplus x_3\bar{x}_6\oplus\bar{x}_1x_4\oplus x_2x_4\oplus x_5x_6\oplus x_4\bar{x}_5\oplus\bar{x}_4x_6\oplus x_2x_6$$

$$P_2=\bar{x}_2x_3\oplus x_1\bar{x}_4\oplus x_2\bar{x}_4\oplus x_3x_6\oplus x_4x_5\oplus x_2x_5\oplus x_1\bar{x}_6\oplus\bar{x}_2x_6$$

$$P_3=x_3x_4\oplus x_3\bar{x}_6\oplus\bar{x}_1x_4\oplus x_2\bar{x}_4\oplus\bar{x}_1\bar{x}_5\oplus x_2\bar{x}_5\oplus\bar{x}_5x_6$$

$$P_4=\bar{x}_2x_3\oplus x_1\bar{x}_4\oplus x_2\bar{x}_4\oplus x_3\bar{x}_6\oplus\bar{x}_5x_6\oplus x_4x_6\oplus x_2x_5\oplus x_1\bar{x}_6\oplus x_2x_6$$

$$P_5=x_3x_4\oplus\bar{x}_3\bar{x}_6\oplus\bar{x}_1\bar{x}_4\oplus\bar{x}_2x_4\oplus\bar{x}_1x_6\oplus x_2x_6\oplus x_5x_6\oplus\bar{x}_5\bar{x}_6$$

$$P_6=\bar{x}_1\bar{x}_5\oplus x_2x_3\oplus x_4\bar{x}_5\oplus\bar{x}_3x_4\oplus x_1x_5\oplus\bar{x}_2\bar{x}_5$$

When $X=(0,\ 0,\ 0,\ 1,\ 0,\ 0)$, $Y=P(X)=(0,\ 0,\ 0,\ 1,\ 1,\ 0)$.

When such a Boolean public key from $Z_{2,n}$ to $Z_{2,n}$ is created, if the n selected is large (e.g., n = 64), it has the capability to resist frequency analysis and exhaustive testing. Furthermore, from the above theorem we know that a time polynomial method does not exist for solving a series of second order equations on GF(2). Therefore, it is a very difficult problem to break the code when the reverse transformation is not known. The key to ensuring the security of a second order Boolean public key is that the secret key is very difficult to crack, i.e., the public key is unidirectional. With regard to this question, we have the following discussion.

Theorem 5. F is a reversible Boolean transform from $Z_{2,n}$ to $Z_{2,n}$. For any reversible linear transform A from $Z_{2,n}$ to $Z_{2,n}$, there is a linear transform A' to make

$$F\cdot A=A'\cdot F$$

Then F must be a linear Boolean transform.

Proof. Because $F=(f_1,\cdots,f_n)$ is a reversible Boolean transform from $Z_{2,n}$ to $Z_{2,n}$, from Lemma 1, as long as $a_1=a_2=\cdots=a_n=0$ does not exist for $a_1,\cdots,a_n\in\{0,\ 1\}$, we get

$$\|a_1f_1\oplus\cdots\oplus a_nf_n\|=2^{n-1}.$$

If $A=(x_1\oplus x_j,x_2,\cdots,x_n)$, $2\leqslant j\leqslant n$, then A is the reversible linear Boolean transform from $Z_{2,n}$ to $Z_{2,n}$. From the theorem, there is a linear Boolean transform A

$$F\cdot A=A'\cdot F$$

If we express f_i as the following

$$f_i(x_1,\cdots,x_n)=x_1g_1(x_2,\cdots,x_n)\oplus\bar{x}_1g_2(x_2,\cdots,x_n)\oplus g_3(x_2,\cdots,x_n)$$

We can obtain the following

$$(x_1\oplus x_j)g_1\oplus(\bar{x}_1\oplus x_j)g_2\oplus g_3=a'_{i1}f_1\oplus\cdots\oplus a'_{in}f_n$$
$$x_j(g_1\oplus g_2)=a'_{i1}f_1\oplus\cdots\oplus(1+a'_{ij})f_j\oplus\cdots\oplus a'_{in}f_n$$

If $x_j(g_1\oplus g_2)\equiv 0$, then $g_1\equiv g_2$, then

$$f_i(x_1,\cdots,x_n)=g_1(x_2,\cdots,x_n)\oplus g_3(x_2,\cdots,x_n)$$

If $x_j(g_1\oplus g_2)\not\equiv 0$, from Lemma 1 we get

$$\|x_j(g_1\oplus g_2)\|=2^{n-1},\quad 2\leqslant j\leqslant n,$$

i.e., $g_1\oplus g_2\equiv 1$. Therefore, $g_1\equiv\bar{g}_2$. Consequently

$$f_i(x_1,\cdots,x_n)=x_1g_1\oplus\bar{x}_1\bar{g}_1\oplus g_3=x_1\oplus\bar{g}_1\oplus g_3$$

In analogy, we can obtain

$$f_i(x_1,\cdots,x_n)=b_{i1}x_1\oplus\cdots\oplus b_{in}x_n\oplus c_i$$

$$b_{ij},c_i\in\{0,\ 1\},\ 1\leqslant i\cdot j\leqslant n$$

Because F is a reversible Boolean transform, we know that $B=(f_1\oplus c_1,\cdots,f_n\oplus c_n)$, $c_1,\cdots,c_n\in\{0,1\}$ is also a Boolean transform with an inverse. Furthermore, B is also a linear Boolean transform.

If we assume $P=(x_1\oplus c_1,\cdots,x_n\oplus c_n)$, then $F=P\cdot B$. P is the reversible Boolean transform from $Z_{2,n}$ to $Z_{2,n}$. For any reversible Boolean transform A from $Z_{2,n}$ to $Z_{2,n}$

$$P\cdot A=P\cdot B\cdot B^{-1}\cdot A\cdot B\cdot B^{-1}=F\cdot B^{-1}\cdot A\cdot B\cdot B^{-1}$$

From the theorem, there is a linear transform A' which satisfies

$$F\cdot B^{-1}\cdot A\cdot B=A'\cdot F$$

Therefore

$$P\cdot A=A'\cdot F\cdot B^{-1}=A'\cdot P$$

Let us discuss the situation in the following three cases:

(1) If $c_1=c_2=\cdots=c_n=0$, then P is a linear Boolean transform. Consequently, $F=P\cdot B$ is also a Boolean transform. Hence the theorem is proved.

(2) If some of the $c_1,\cdots,c_n$ are 1 and some are 0, let us assume that $c_1 = 1$, $c_2 = 0$, and A = $(x_2,x_1,x_3,\cdots,x_n)$, then there is a linear Boolean transform A' which satisfies the following

$$P\cdot A = A'\cdot P$$

Then

$$x_2\oplus c_1=a'_{11}(x_1\oplus c_1)\oplus a'_{12}(x_2\oplus c_2)\oplus\cdots\oplus a'_{1n}(x_n\oplus c_n)$$
$$1=a'_{11}(x_1\oplus c_1)\oplus(a'_{12}\oplus 1)(x_2\oplus c_2)\oplus\cdots\oplus a'_{1n}(x_n\oplus c_n)$$

It contradicts deduction 1 and this case will not happen.

(3) If $c_1=c_2=\cdots=c_n=1$, when A = $(x_1\oplus x_2,x_2,\cdots,x_n)$, there is a linear Boolean transform A' which satisfies

$$P\cdot A=A'\cdot P$$
$$\bar{x}_1\oplus x_2=a'_{11}\bar{x}_1\oplus a'_{12}\bar{x}_2\oplus\cdots\oplus a'_{1n}\bar{x}_n,$$
$$1=(a'_{11}\oplus 1)\bar{x}_1\oplus(a'_{12}\oplus 1)\bar{x}_2\oplus\cdots\oplus a'_{1n}\bar{x}_n,$$

Again, it contradicts deduction 1 and will not happen. In summary, F can only be a linear Boolean transform.

Deduction 2. F is a reversible Boolean transform from $Z_{2,n}$ to $Z_{2,n}$. If A is one arbitrary reversible linear Boolean transform and there is a linear Boolean transform A' which satisfies

$$A\cdot F = F\cdot A'$$

then, F is also a linear Boolean transform.

Proof. For an arbitrary reversible linear Boolean transform A, there is a linear reversible Boolean transform A' which satisfies

$$A\cdot F = F\cdot A'$$

Furthermore, for reversible Boolean transforms A and A' if

$$A\cdot F=A''\cdot F=F\cdot A'$$

then

$$A\cdot F\cdot F^{-1}=A=A''\cdot F\cdot F^{-1}=A''$$

Subsequently, we can establish the fact that the reversible linear Boolean transform set from $Z_{2,n}$ to $Z_{2,n}$ corresponds to itself one to one. Therefore, for an reversible Boolean transform A', there is always a linear Boolean transform A so that

$$F \cdot A = A' \cdot F$$

From Theorem 4 one knows that F is a linear Boolean transform.

From Theorem 4 and Deduction 2 one knows that when a Boolean public key is created in the form of A·F·B it cannot be converted to the F·A' or A'·F form because F is usually not chosen as a linear Boolean transform. Thus, it creates some difficulty in solving the secret key from the public key.

The inverse of a second order Boolean transform is not necessarily a second order Boolean transform. For example, in the second order Boolean transform introduced above $F = (x_1 \oplus h_1(x_2, \cdots, x_n), \cdots, x_{n-1} \oplus h_{n-1}(x_n), x_n)$, $h_1, \cdots, h_{n-1}$ are second order Boolean functions. Its inverse $G=(g_1, \cdots, g_n)$, where

$$g_n = y_n$$
$$g_{n-1} = y_{n-1} \oplus h_{n-1}(y_n)$$
$$g_{n-2} = y_{n-2} \oplus h_{n-2}(y_{n-1} \oplus h_{n-1}(y_n),\ y_n)$$
$$g_{n-3} = y_{n-3} \oplus h_{n-3}(y_{n-2} \oplus h_{n-2}(y_{n-1} \oplus h_{n-1}(y_n), y_n), y_{n-1} \oplus h_{n-1}(y_n),\ y_n)$$
$$\vdots$$

As long as $h_1, \cdots, h_{n-1}$, are properly chosen, G is usually not a second order Boolean transform. If a second order Boolean public key is created in the A.F.B form and F is suitably chosen, the Boolean expression of the components of its inverse $B^{-1} \cdot F^{-1} \cdot A^{-1}$ will be too long to write. Therefore, it will be very difficult to find the code from such a second order Boolean public key.

Another way to break such a second order Boolean public key in the form of A·F·B is to find these three transforms A,F, and B from the public key P. Usually we can only assume that A·B is a matrix with n^2 unknowns and write a general expression for F with unknown elements:

$$A \cdot F \cdot B = P$$

to list a series of second order equations on GF(2). However, we realize that it is difficult to solve a series of equations on GF(2). Hence it is very hard to break the code this way.

Similar to other public key systems such as the RSA system and the trap door knapsack problem, the second order Boolean public key also has an implementation problem. For instance, a second order Boolean public key from $Z_{2,n}$ to $Z_{2,n}$ usually has over 1,000 second order terms in the Boolean expression of a component of the public key F. The entire public key could be around 64,000 terms. If we present the public key as a program and build a special Boolean

operator, we will be able to encode 20,000 bits per second at the present level. It is much faster than the RSA system which can encode several thousand bits per second.

In conclusion, with regard to security and execution speed, the second order Boolean public key is a promising new public key cryptosystem.

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APPLIED SCIENCES

DEVELOPMENT OF ROBOTS, ROBOTICS DISCUSSED

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[Article by Zhu Jianying [2612 0494 5391] of the Nanjing Institute of Aeronautics and Astronautics]

[Text] Robots and robotics are a new science and technology developed in the last 20 years. Because robots can be used in a wide range of applications, more and more countries are paying attention to this technology. The economic benefits are apparent and the quality of products can be assured. Furthermore, they can replace people to perform dangerous or special tasks. Eventually, they may alter the manufacturing system and the society. In robotic technology, the United States and Japan are in the leading positions. The USSR is also not far behind. Developed countries such as Germany, England and France are comparable in the quality of their robots but far behind in quantity. They have increased their investment each year in order to obtain rapid growth. It is estimated that robotics will be the fastest-growing new technology in the developed nations. China has just begun to get involved in this area. It has not yet received any attention. Hence, I decided to introduce robots and robotics in this paper in order to stir up some interest.

I. Introduction

1. Definition of Robots and Robotics

The term "robot" was first used by the Czech playwright Karel Capek. He named an absolutely obedient slave as a robot in his play. Later, people called any machine which did whatever one wished a robot. It is believed that the first person who thought to use robots in work was G. C. Devol, an American engineer. He is also the founder of a major robot manufacturer.[1] People usually imagine that the appearance and function of a robot are similar to those of a modern man. In fact, both are quite different. A robot does not necessarily have the appearance of a human being. It only has some sensors to emulate certain functions of the human body. Therefore, some people suggest that a robot should not be translated as a "mechanical man." However, we are used to this translation. As long as the term "mechanical man" is not considered a person but a machine, it will do.

The definition of robot and robotics given by the Robot Institute of America (RIA) are as follows:

A robot is a programmable manipulator which can be used to move materials, tools or special equipment. Various types of tasks can be completed by programming.

Robotics is the fundamental structure and operation of a robot based on an intelligent computer. Generally speaking, robotics includes both fundamental and applied research. Its contents can primarily be divided into five major parts: 1) manipulator; 2) sensor; 3) programming; 4) planning system; and 5) device and system structure.

One can see that robotics is very broad. It is a large system combining mechanics, machines, biology, control theory, computers, artificial intelligence and systems engineering. Therefore, robotics is not only a discipline but also a multidisciplinary science.

2. Status and Development Trend

As with any science and technology, the growth cannot be separated from production needs. Robot and robotics were developed because of the need for automation in manufacturing. Teleoperators and digital machine tools were the earliest robots.[2] During World War II, a simple teleoperator was designed to produce and process radioactive materials. The operator could move with 6 degrees of freedom through an observation and manipulation mechanism behind a very thick radiation-resistant wall in order to reach the desired position and direction. In 1947, the first electric servo teleoperator was made. The servo principle was used to allow the executing component to track down an active component. In the same year, because of the need to manufacture advanced aircraft, the radiation laboratory at MIT began to develop a digital-controlled milling machine with support from the U.S. Air Force. In 1953, this milling machine was demonstrated for the first time.

The regular robot began to emerge in the early 1960's. In 1961, MIT's Lincoln Lab developed a computer-controlled robot with a sense of touch.[3] It could determine the shape of an object by touch but could not conduct any trigonometric calculation of the coordinates. Therefore, its application was limited. In 1963, Roberts developed the homogeneous coordinate transformation method[4] to determine the position and orientation of a robot. This method is still used to control the position of a robot. At about the same time, the first Unimate industrial robot was introduced.[5] It could store any "demonstrated" motion in the computer's memory. Later, this information could be retrieved to make the robot repeat any "demonstrated" motion.

In 1967, computer-controlled sighted robots equipped with cameras were introduced.[6] The camera was used to determine the position of the object, and the rotation angle of each joint and the displacement of the arm were calculated by homogeneous coordinate transformation.

The 1970's were a booming decade for robots. Various coordinate systems and robot structures were introduced. In addition to research in the laboratory, they were widely used in industry. Figure 1 shows the productivity of major robot manufacturers in the United States between 1975 and 1980. According to

the statistics kept by the Robot Institute of America, the number of robots owned by various nations as of October 1981 is shown in Table 1.

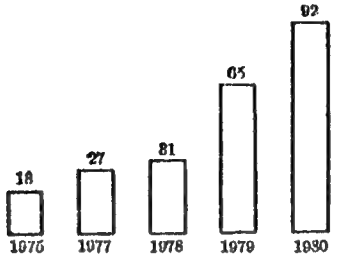

Figure 1. Total Productivity of Major U.S. Manufacturers of Robots (SAEA Prab, Devibiss, Cincinnati Milacron, Unimation) (in millions of U.S. dollars)

Table 1. Number of Robots in Various Countries as of October 1981

Nation	Number of intelligent robots	Number of nonintelligent robots	Number of mechanical transport machines
Japan	6,899	7,347	53,189
United States	2,400	1,700	10,000
Federal Republic of Germany	1,120	300	
Switzerland	50		8,000
Czechoslovakia	200	130	200
Poland	175	65	120
Denmark	36	30	110
Finland	51	65	51
Belgium	42		82
The Netherlands	51		30
Yugoslavia	5	5	15
Total	11,029	9,642	71,897

The situation in the USSR was not clear in the past. According to recent information, the growth has been very rapid. Russian scholar Popov[7] pointed out that the number of robots produced in the USSR between 1976 and 1980 exceeded 8,000. It is estimated that the quantity will triple between 1981 and 1985.

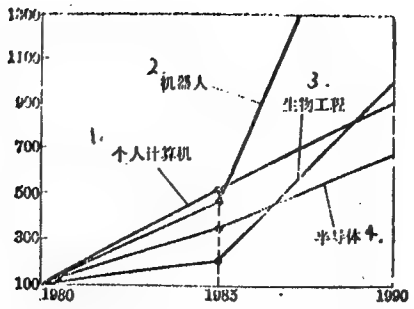

Figure 2. The Four Leading Modern Technologies (1980 indicator as 100)

Key:
1. Personal computer
2. Robot
3. Genetic engineering
4. Semiconductor

As Japanese scientists I. Kato and Y. Hasegawa pointed out in their report ("Status of Robotic Technology") at the Eighth Annual Meeting of the International Federation of Automatic Control (IFAC) in Kyoto, Japan, in August 1981, more than 20,000 new robots would join the work force in Japan in 1981. It is projected that Japan will be able to produce $1.2 billion of robotic products each year by 1985. By 1990, it may reach $2.1 billion. The productivity of robots in the United States may also reach $1.9 billion by 1990. According to information provided by Prof Tang Zizhong of Washington University in the United States in his lecture in China, the growth of robots will lead the four rapidly growing modern technologies in the United States from 1985 until the end of the century (Figure 2).

3. Application of Robots

There is a wide range of applications for robots. The main areas are: 1) for tedious, repetitious, cumbersome and simple operations such as assembling parts and products with robots, operating punches and moving heavy objects in the shop; 2) for hazardous and unhealthy environments such as spray painting, welding, electroplating and electrolysis; 3) for dangerous jobs such as working under radiation, fire fighting and work in outer space; 4) for high-precision tasks such as automatic centering, high-precision assembly and high-accuracy positioning and detection; 5) for special jobs such as servicing the wards, leading the blind, operating artificial limbs, running the S-shaped machine for stomach examinations, heart surgery without opening the chest and other surgical procedures), operating wall-climbing machines for automatic welding of hulls) and elephant trunk machines (for moving heavy objects); and 6) for flexible manufacturing systems to pave the way for small-batch automation. Finally, it can create the necessary conditions for realizing "unmanned plants" (not totally unmanned but with a small number of maintenance, management and design personnel).

In the aforementioned area, not only can the quality of products be assured but the productivity can also be greatly improved when robots are used. The production condition will be significantly improved because the "human-machine"

relation is changed to the "human-robot-machine" relation. People are no longer dealing with machines. In addition, when robots replace people to perform hard labor, people will have more time to get involved in education, science, culture and sports. It will fundamentally change work and life styles. In summary robots will have a major influence on the material and spiritual civilization of mankind.

4. Types and Performance of Existing Robots

Robots are classified differently in various countries. The Japanese Industrial Robot Association (JIRA) classifies robots by degree of complexity into six categories: 1) manual manipulator; 2) fixed-program robot; 3) programmable robot; 4) emulation robot; 5) digitally controlled robot; and 6) intelligent robot.

The Robot Institute of America does not consider categories 1) and 2) above as robots. Instead, robots are classified into four categories, i.e., 3)-6). The USSR divides robots into three generations[7]: 1) first generation: programmable robots; 2) second generation: robots with densing and control capabilities; and 3) third generation: artificial intelligence robots. The first-generation robots can act according to specific written programs. This type of robot has touch, force position, vision and heat sensors. Signals obtained by the sensors are processed by the computer in the robot to accomplish a specific job. This kind of robot can do such jobs as assembling, welding and spray painting. The third-generation robot has more sensors. It can "identify" and make "decisions" through "thinking." Hence, it has enough intelligence to perform complicated actions such as going around obstacles, obeying voice commands, reaching a destination via the optimal trajectory and speed and reacting differently to different environments. These generations of robots coexist in the real world.

Robots can be classified by the driving mechanism, e.g., hydraulic, pneumatic, electric or hybrid. They can also be classified by the number of joints (3-8), degrees of freedom (3-12), load (several grams to several hundred kg), etc.

Presently, an industrial robot can reach the following performance level: 1) it has six joints; 2) it can be "taught," i.e., robots can be taught by an operator; 3) it can store information up to the desired capacity; 4) it can select a specific program, i.e., it is capable of choosing a corresponding program by a given signal to finish the job; 5) it has an accuracy of 0.3 mm in repeated positioning and 0.05 mm in special applications; 6) it can handle up to 150 kg; 7) it has the capability for point control or continuous path control; 8) it has a computer interface; 9) it is highly reliable with a mean breakdown-free time (MTBF) of not less than 400 hours; and 10) it is economical. A medium-level robot costs approximately $10-20,000. The cost can be recovered in 2-4 years.

Future robots are expected to: 1) have a sense of vision; 2) have touch sensors and force feedback; 3) process visual and touch signals by computer; 4) have multiple arms; 5) have a multi-axis high speed; 6) move along an arbitrary trajectory controlled by computer; 7) have high flexibility;

8) occupy less space and consume less energy; 9) allow man-robot dialog; and 10) be safer and more economical.

II. Robotic Kinetics

1. Robotic Coordinate Systems and Terminology

Present industrial robotic coordinate systems can be divided into four categories by their kinetic and geometric characteristics (see Figure 3): 1) Cartesian coordinates (three linear axes); 2) cylindrical coordinates (two linear axes and a rotating axis); 3) spherical coordinates or polar coordinates (line linear axis and two rotating axes); and 4) rotating coordinates (all rotating axes).

Regardless of type, a robot is composed of a base, links, joints and end effectors. Figure 4 is a typical industrial robot. It has 6 degrees of freedom, all rotational. In the diagram, the shoulder, elbow and wrist are all joints. The arm is the link. The wrist is more complicated, which rotates in three ways. The finger at the end is capable of picking up objects. It is the end effector.

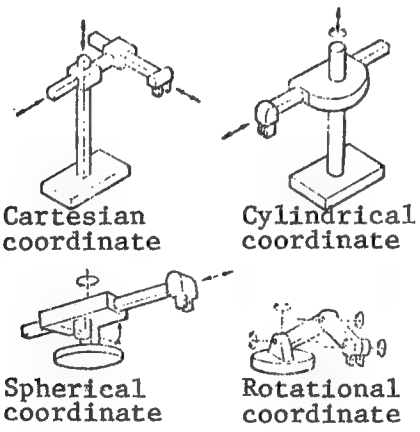

Figure 3. Various Coordinates for Robots

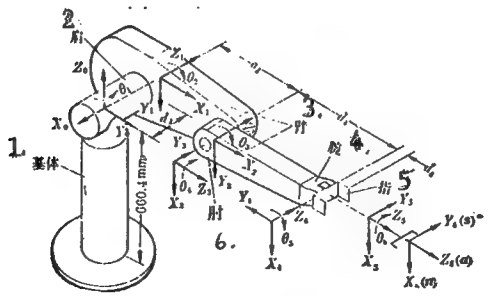

Figure 4. Typical Industrial Robot With 6 Degrees of Freedom

Key:

1. Base
2. Shoulder
3. Arm
4. Wrist
5. Finger
6. Elbow

2. Basic Problems in Robotic Kinetics

In Figure 4, the coordinate at the base (X_0, Y_0, Z_0) is the reference coordinate. Other coordinates fixed at other locations (X_i, Y_i, Z_i), $i = 1,2,\cdots,6$, are body-attached coordinate frames. The coordinate (X_6, Y_6, Z_6), i.e. coordinate (n, s, a), is also called the end coordinate. The coordinates are right-handed.

The problems in robotic kinetics are the motion geometry, velocity and acceleration of the end effector with respect to the reference coordinate at the base. They do not involve forces or moments and can usually be classified into two major categories:

1) Forward problems: these look for the position and direction of the end effector relative to the reference coordinate (as a function of time), knowing all the rotation angles $\theta = (\theta_1, \cdots, \theta_6)^t$ of the joints of the robot.

2) Reverse problems: these calculate the angular vector $\theta = (\theta_1, \cdots, \theta_6)^t$ at each joint with a given position and direction of the end effector relative to the reference coordinate.

The two problems mentioned above are illustrated in Figure 5. In the diagram, T is a homogeneous transformation matrix which will be introduced in the following. Reverse problems are more difficult to solve. Furthermore, its solution is not unique.

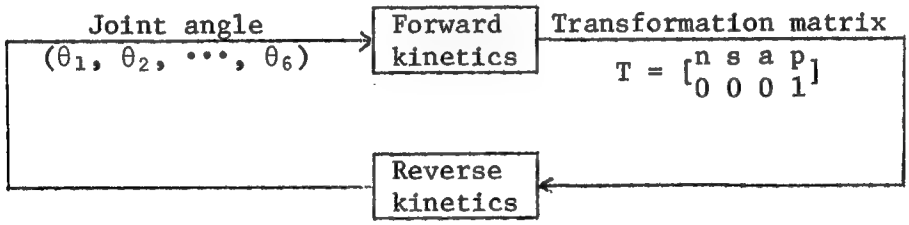

Figure 5. Forward and Reverse Problems in Robotic Kinetics

3. Rotational Transformation Matrix

Let us look at two right-handed rectangular coordinates (see Figure 6): OXYZ--the reference coordinate--and OUVW--the body-attached coordinate. A point P in space can be expressed by the vector OP from the origin. It is noted simply as P. The same vector P is expressed differently in a different coordinate:

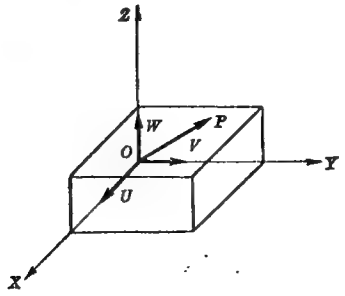

Figure 6. Reference Coordinate and Body-attached Coordinate

$$p_{UVW}=(p_U, p_V, p_W)', \tag{1}$$

$$p_{XYZ}=(p_X, p_Y, p_Z)', \tag{2}$$

where p_U, p_V, p_W, p_X, p_Y and p_Z represent the projections of the vector p in the corresponding coordinates, respectively. Based on the numerical product of vectors and the vector matrix expression, we get

$$p_{XYZ}=Ap_{UVW}, \tag{3}$$

$$p_{UVW}=Bp_{XYZ}, \tag{4}$$

where

$$A=\begin{bmatrix} i_X\cdot i_U & i_X\cdot j_V & i_X\cdot k_W \\ j_Y\cdot i_U & j_Y\cdot j_V & j_Y\cdot k_W \\ k_Z\cdot i_U & k_Z\cdot j_V & k_Z\cdot k_W \end{bmatrix}, \tag{5}$$

$$B=\begin{bmatrix} i_U\cdot i_X & i_U\cdot j_Y & i_U\cdot k_Z \\ j_V\cdot i_X & j_V\cdot j_Y & j_V\cdot k_Z \\ k_W\cdot i_X & k_W\cdot j_Y & k_W\cdot k_Z \end{bmatrix}. \tag{6}$$

where A and B are the transformation matrices, where i_X, j_Y, k_Z are the unit vectors in the OXYZ coordinate and where i_U, j_V and k_W are the unit vectors of the OUVW coordinate.

Let $R_{X,\alpha}$, $R_{Y,\varphi}$, $R_{Z,\theta}$ be the transformation matrix after the OUVW coordinate is rotated about the X,Y,Z axes by angles of α,φ,θ, respectively. From Equation (5) one gets

$$R_{X,\alpha}=\begin{bmatrix} 1 & 0 & 0 \\ 0 & c\alpha & -s\alpha \\ 0 & s\alpha & c\alpha \end{bmatrix}, \tag{7}$$

$$R_{Y,\varphi}=\begin{bmatrix} c\varphi & 0 & s\varphi \\ 0 & 1 & 0 \\ -s\varphi & 0 & c\varphi \end{bmatrix}. \tag{8}$$

$$R_{Z,\theta}=\begin{bmatrix} c\theta & -s\theta & 0 \\ s\theta & c\theta & 0 \\ 0 & 0 & 1 \end{bmatrix}. \tag{9}$$

where s = sin and c = cos. It is easy to see that when the rotation angle around each axis is the same and the order of rotation is different, the rotational transformation matrix is different. For example, if we rotate about the OX axis by α, the OZ axis by θ and the OY axis by φ, then the overall transformation matrix is

$$R_1 = R_{Y,\varphi}\, R_{Z,\theta}\, R_{X,\alpha}$$
$$= \begin{bmatrix} c\varphi c\theta & s\varphi s\alpha - c\varphi s\theta c\alpha & c\varphi s\theta s\alpha + s\varphi c\alpha \\ s\theta & c\theta c\alpha & -c\theta s\alpha \\ -s\varphi c\theta & s\varphi s\theta c\alpha + c\varphi s\alpha & c\varphi c\alpha - s\varphi s\theta s\alpha \end{bmatrix},$$

However, if we first rotate about the OY axis by φ, the OZ axis by θ and then the OX axis by α, the overall transformation axis is

$$R_2 = R_{X,\alpha}\, R_{Z,\theta}\, R_{Y,\varphi}$$
$$= \begin{bmatrix} c\theta c\varphi & -s\theta & c\theta s\varphi \\ cas\theta c\varphi + sas\varphi & cac\theta & cas\theta s\varphi - sac\varphi \\ sas\theta c\varphi - cas\varphi & sac\theta & sas\theta s\varphi + cac\varphi \end{bmatrix},$$

Obviously, $R_1 \neq R_2$.

It should be particularly pointed out that if we rotate about a certain axis OU, OV or OW of the body-attached coordinate after the rotation, when we synthesize the overall transformation matrix from individual transformation matrices, the sequence of multiplication is just the reverse of the one used to synthesize from rotating around the axes of the reference coordinate. For example, if we rotate around the OZ axis by an angle φ, then around the OU axis by θ and finally around the OW axis by ψ, then the overall transformation matrix is

$$R_{\varphi,\theta,\psi} = R_{Z,\varphi}\, R_{U,\theta}\, R_{W,\psi}$$
$$= \begin{bmatrix} c\varphi c\psi - s\varphi s\theta s\psi & -c\varphi s\psi - s\varphi c\theta c\psi & s\varphi s\theta \\ s\varphi c\psi + c\varphi c\theta s\psi & -s\varphi s\psi + c\varphi c\theta c\psi & -c\varphi s\theta \\ s\theta s\psi & s\theta c\psi & c\theta \end{bmatrix}.$$

4. Homogeneous Transformation Matrices

The aforementioned 3 x 3 rotational transformation matrix only gives the effect of coordinate rotation. It does not involve translation and scale change (magnification or reduction). For this purpose, we will add another coordinate axis. In other words, an η component vector is expressed by $(\eta + 1)$ components. This coordinate expression is called the homogeneous coordinate expression. In a homogeneous coordinate, any three dimensional vector $p = (p_X, p_Y, p_Z)^t$ can be expressed as a four-dimensional vector

$$\hat{p} = (X, Y, Z, W)^t, \tag{10}$$

where

$$p_X = \frac{X}{W}, \quad p_Y = \frac{Y}{W}, \quad p_Z = \frac{Z}{W}. \tag{11}$$

Obviously, this expression is not unique. For example, the same vector $p = (1,2,3)^t$ can be expressed in a homogeneous coordinate as

$$\hat{p}_1 = (1, 2, 3, 1)^t,$$
$$\hat{p}_2 = (2, 4, 6, 2)^t,$$
$$\vdots$$

The transformation matrix in a homogeneous coordinate is called a homogeneous transformation matrix, which is a 4 x 4 matrix. This matrix can express not only the rotation of the coordinate but also the translation, magnification and reduction of the coordinate. Usually, it can be divided into four sub-matrices.

$$T = \begin{bmatrix} R_{3\times3} & \vdots & p_{3\times1} \\ \cdots\cdots & \vdots & \cdots\cdots \\ f_{1\times3} & \vdots & \alpha_{1\times1} \end{bmatrix} = \begin{bmatrix} \text{rotational matrix} & \vdots & \text{position vector} \\ \cdots\cdots & \vdots & \cdots\cdots \\ \text{perspective transformation} & \vdots & \text{proportional factor} \end{bmatrix} \tag{12}$$

In robotic kinetics, the perspective transformation $f_{1\times3} = 0$.

After the origin of the OXYZ coordinate 0 is translated by dx, dy and dz, the corresponding homogeneous transformation matrix is:

$$T = \begin{bmatrix} 1 & 0 & 0 & dx \\ 0 & 1 & 0 & dy \\ 0 & 0 & 1 & dz \\ 0 & 0 & 0 & 1 \end{bmatrix}. \tag{13}$$

If the OUVW coordinate is reduced or magnified by a factor α with respect to the OXYZ axes, then the corresponding homogeneous transformation matrix is:

$$T = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & \alpha \end{bmatrix}. \tag{14}$$

In order to find the homogeneous transformation matrix of the end effector relative to the reference coordinate, we must first obtain the homogeneous transformation matrix for two neighboring link coordinates.

5. Composition of the Homogeneous Transformation Matrix

Figure 7 shows the coordinates of two arbitrary links, L_{i-1} and L_i, on a robot. The corresponding joints are J_{i-1}, J_i and J_{i+1}. The rotational axis of each joint is in the Z-axis direction of its respective body-attached coordinate. The common normal direction of the Z axis of the two neighboring joints is in the X-axis direction. The Y-axis direction is determined by the right-hand rule. In the figure, the length of the common normal a_{i-1} and a_i is the link length. The distance between two common normals, d_i, is called the link gap. The angle θ_i measured between two common normals on the plane perpendicular to the joint axis is called the angle of rotation. The angle between two neighboring joint axes, α_i, is called the twist angle.

a_i, α_i, d_i and θ_i are the four important parameters. They determine the homogeneous transformation matrix between two coordinates.

From Figure 7 we know that the coordinate $O_{i-1}\ X_{i-1}Y_{i-1}\ Z_{i-1}$ will coincide with the coordinate $O_iX_iY_iZ_i$ by rotating the $O_{i-1}X_{i-1}$ axis by angle θ_i so that it will be in the same direction as the O_iX_i axis. Then the origin O_{i-1} is shifted by the distance d_i. In the coordinate after the move, it is shifted by the distance d_i. In the coordinate after the move, it is shifted by the length a_i along the $O_{i-1}X_{i-1}$ axis so that O_{i-1} coincides with O_i. Finally, we rotate about the $O_{i-1}X_{i-1}$ axis (i.e., the O_iX_i axis) by an angle α_i so that the direction of the Z_{i-1} axis coincides with that of the Z_i axis.

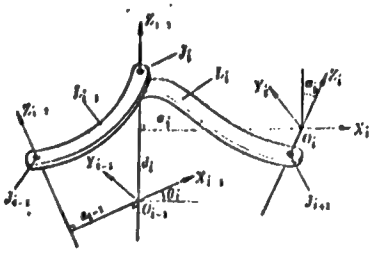

Figure 7. Coordinate Systems on Neighboring Links

The homogeneous transformation matrix of the end effector relative to the fixed coordinate on the base has the following general form:

$$T=\begin{bmatrix} n & s & a & p \\ 0 & 0 & 0 & 1 \end{bmatrix}=\begin{bmatrix} n_X & s_X & a_X & p_X \\ n_Y & s_Y & a_Y & p_Y \\ n_Z & s_Z & a_Z & p_Z \\ 0 & 0 & 0 & 1 \end{bmatrix}, \tag{15}$$

where n, s, a are the unit vectors of the end coordinate, p is the position vector of the origin of this coordinate, and n_X, s_X, a_Y, p_Z, ••• are the components of those vectors mentioned above in the reference coordinate. Hence, the homogeneous transformation matrix in Equation (15) can completely express the changes of the end coordinate relative to the reference coordinate.

6. Solving Reverse Problems in Robotic Kinetics

In reality, very often we want to know how the joints of a robot should be turned in order to allow the end effector to reach a specific position.

For a typical industrial robot with 6 degrees of freedom, this reverse problem can be solved in two steps. The first step is to find the position vector p from the origin of the reference coordinate (X_0, Y_0, Z_0) to the origin of the wrist coordinate (see Figure 8). Based on this, the first three rotation angles θ_1, θ_2 and θ_3 are found. The second step is to find θ_4, θ_5 and θ_6 from these angles calculated and the homogeneous transformation matrix $T_0^{\ i}$, i = 4, 5, 6.

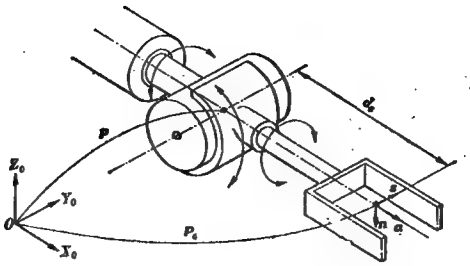

Figure 8. Coordinates To Solve Reverse Problems

According to the above procedure, the turning angles of a 6 degree of freedom robot can be obtained from Figure 8.

$$\theta_1=\mathrm{tg}^{-1}\left[\frac{\pm p_Y\sqrt{p_X^2+p_Y^2-d_2^2}-d_2p_X}{\pm p_X\sqrt{p_X^2+p_Y^2-d_2^2}+d_2p_Y}\right], \tag{16}$$

$$\theta_3=\mathrm{tg}^{-1}\left[\frac{-p_Z(a_2+d_4s_3)+(d_4c_3)(\pm\sqrt{p_X^2+p_Y^2-d_2^2})}{p_Z(d_4c_3)-(a_2+d_4s_3)(\pm\sqrt{p_X^2+p_Y^2-d_2^2})}\right], \tag{17}$$

$$\theta_{3}=\mathrm{tg}^{-1}\left[\frac{p_X^2+p_Y^2+p_Z^2-d_4^2-a_2^2-d_2^2}{\pm\sqrt{4d_4^2a_2^2-(p_X^2+p_Y^2+p_Z^2-d_4^2-a_2^2-d_2^2)^2}}\right], \tag{18}$$

$$\theta_4=\mathrm{tg}^{-1}\left[\frac{c_1a_Y-s_1a_X}{c_1c_{23}a_X+s_1c_{23}a_Y-s_{23}a_Z}\right], \tag{19}$$

$$\theta_5=\mathrm{tg}^{-1}\left[\frac{(c_1c_{23}c_4-s_1s_4)a_X+(s_1c_{23}c_4+c_1s_4)a_Y-c_4s_{23}a_Z}{c_1s_{23}a_X+s_1s_{23}a_Y+c_{23}a_Z}\right], \tag{20}$$

$$\theta_6=\mathrm{tg}^{-1}\left[\frac{(-s_1c_4-c_1c_{23}s_4)n_X+(c_1c_4-s_1c_{23}s_4)n_Y+(s_4s_{23})n_Z}{(-s_1c_4-c_1c_{23}s_4)s_X+(c_1c_4-s_1c_{23}s_4)s_Y+(s_4s_{23})s_Z}\right]. \tag{21}$$

where $c_i=\cos\theta_i$, $s_i=\sin\theta_i$, $c_{ij}=\cos(\theta_i+\theta_j)$, $s_{ij}=\sin(\theta_i+\theta_j)$, $i, j=1, 2, 3, 4$.

III. Robotic Kinetics

The purpose of studying robotic kinetics is to find out the dynamic behavior of various parts of a robot and express it by a series of mathematical equations. The purposes are: 1) to facilitate the simulation of the motion of a robot's arm by a computer; 2) to design an appropriate control system for the robot; and 3) to provide the basis for the structural design of various parts of a robot.

There are many ways to describe and solve a robotic kinetic problem. Each has advantages as well as disadvantages. For example, there are the Lagrange-Euler equation, the Newtonian-Euler equation, the iterated Lagrange-Euler

equation and the generalized d'Alembert equation. Due to limited space, only several fundamental methods and results are introduced in this paper.

1. The Lagrange-Euler Equation of Motion

The following equation is a Lagrange-Euler equation of motion:

$$\frac{d}{dt}\left(\frac{\partial L}{\partial \dot{q}_i}\right)-\frac{\partial L}{\partial q_i}=\tau_i,\ i=1,\ 2,\cdots,n, \tag{22}$$

where L = K-P is a Lagrange function, K is the kinetic energy, P is the potential energy, q_i is a generalized coordinate, $\dot{q}_i$ is the first-order derivative of the generalized coordinate q_i and τ_i is the generalized force (or moment) exerted on the system.

The key to finding the generalized force by Equation (22) is to locate the mathematical expressions for the kinetic and potential energies of the system and their partial derivatives with respect to the generalized coordinate. The effect of motion at any joint of the robot on the velocity of a particle on the link can be obtained by the homogeneous transformation matrix and its derivative from the i to the i-1 coordinate system. Then, the kinetic and potential energies of the system can be determined. For a robot with η degrees of freedom, the final generalized force equation is:

$$\tau_i=\sum_{k=1}^{n} C_{ik}\ddot{q}_k+\sum_{k=1}^{n}\sum_{m=1}^{n} C_{ikm}\dot{q}_k\dot{q}_m+C_i, \tag{23}$$

where C_i is the load on the link i, C_{ikm} is the coefficient of centrifugal (when m = k) and Ge's force (when m = k) on the link i is caused by the angular velocity at joints k and m and C_{ik} is the coefficient of the acceleration term.

Equation (23) is a nonlinear, coupled second-order differential equation. Furthermore, the coupling is very strong. It is impossible to solve it by the weak coupling theory for a large system. Therefore, an analytical solution cannot be found. Many methods were developed to find approximate solutions. For example, the Ge's force and centrifugal force terms were neglected.[8,9] However, it is only applicable to low-speed robots. Someone developed an iterative Lagrange-Newtonian equation.[13] However, this iterative equation destroys the "structure" which is a useful kinetic model in designing a controller. A generalized d'Alembert principle was developed[12] to obtain an effective equation of motion. It employs the rotational matrix of the joint and the relative position vector to increase the efficiency of calculation.

2. Newtonian-Euler Equation of Motion[11]

The general form of the Newtonian-Euler equation of motion is

$$F=m\frac{dv}{dt}=ma, \tag{24}$$

where F is the external force exerted on the system, ν is the velocity of the center of mass of the system, m is the mass of the system and a is the acceleration of the center of mass.

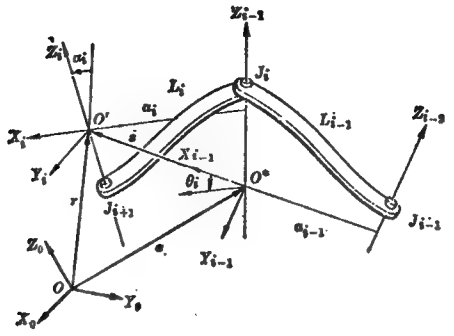

Figure 9. Relation Between the (0, 0*) and (0, 0') Frames

Figure 9 shows the coordinate systems of two neighboring links where r, e and s represent the relative position vectors of the three origins 0, 0' and 0*, respectively. Let ν_e and ω_e be the linear velocity and angular velocity of the $(X_{i-1}, Y_{i-1}, Z_{i-1})$ coordinate relative to the base coordinate (X_0, Y_0, Z_0), respectively. ω_r and ω_s are the respective angular velocities of the (X_i, Y_i, Z_i) coordinate with respect to (X_0, Y_0, Z_0) and $(X_{i-1}, Y_{i-1}, Z_{i-1})$. The linear velocity ν_r, angular velocity ω_r, linear acceleration $\dot{\nu}_r$ and angular acceleration $\dot{\omega}_r$ of the (X_i, Y_i, Z_i) coordinate with respect to the base coordinate are

$$v_r = \frac{d^* s}{dt} + \omega_e \times s + v_e , \tag{25}$$

$$\omega_r = \omega_e + \omega_s , \tag{26}$$

$$\dot{v}_r = \frac{d^{*2} s}{dt^2} + \dot{\omega}_e \times s + 2\omega_e \times \frac{d^* s}{dt} + \omega_e \times (\omega_e \times s) + \dot{v}_e , \tag{27}$$

$$\dot{\omega}_r = \dot{\omega}_e + \dot{\omega}_s , \tag{28}$$

The angular acceleration $\dot{\omega}_s$ is

$$\dot{\omega}_s = \frac{d^* \omega_s}{dt} + \omega_e \times \omega_s , \tag{29}$$

where d*( )/dt represents the time derivative relative to the moving coordinate $(X_{i-1}, Y_{i-1}, Z_{i-1})$.

By applying the above equations to neighboring links, we can obtain the iterative formulas for the angular acceleration, linear acceleration, force and moment of the center of mass.[21]

IV. Trajectory of Motion

A robot cannot directly and horizontally move an object from one point to another. It must lift the object and then move it along a specific trajectory to the destination. Finally, it slowly places the object at the final position. Therefore, the arm motion of a robot must be designed in such a way that the position, velocity and acceleration requirements at the start and the finish as well as the coordinates of the ascending and descending points are satisfied (see Figure 10). A 7th-order polynomial can generally be used to simulate the aforementioned eight conditions:

$$\theta(t) = a_7 t^7 + a_6 t^6 + \cdots + a_1 t + a_0. \tag{30}$$

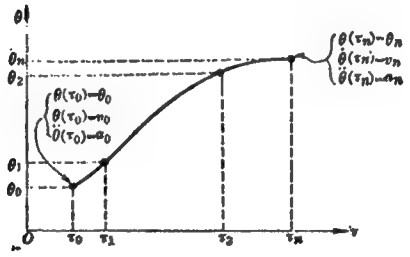

Figure 10. Boundary Condition of the Joint Motion Trajectory

This is a higher-order equation. Since it is necessary to calculate for each joint, the workload is very high. In order to simplify it, we can do it by sections. Each section of the trajectory is described by a lower-order polynomial and then continuity of position, of velocity and of acceleration at the junction is insured to avoid any unstable motion. The trajectory can be divided by the following methods:

1. The 4-3-4 Trajectory

The motion of each joint is divided into three segments. The first segment, which is simulated by a fourth-order polynomial, begins with the start and ends at the lift point. The second segment, which is simulated by a third-order polynomial, begins with the lift point and moves to the drop point. The final segment, which is also expressed by a fourth-order polynomial, begins with the drop point and goes to the end.

2. The 3-5-3 Trajectory

Similar to the 4-3-4 trajectory, the orders of polynomials used for the various segments are 3, 5 and 3. However, we wish to point out that the sum of the orders should be the same (4+3+4 = 3+5+3 = 11).

3. The 3-3-3-3-3 Trajectory

The motion of each joint is divided into five segments and each segment is expressed by a third-order polynomial.

Regardless of which method is used, all the joints of the robot must be calculated. For example, if the 4-3-4 trajectory is used to calculate a robot with six joints, then there are 6x3 = 18 segments. It is necessary to calculate the coefficients 6x14 = 84 polynomials and 18 trajectory vertices. Obviously, these computations cannot be made possible without computers.

V. Control of Robots

For a given equation of motion, the objective of robotic control is to make all the parts of a robot move along an ideal track. Figure 11 shows the principle of robotic cybernetics. The arm movement of the robot is detected by force sensors and delivered to the controller. It is compared against the planned trajectory and force parameters. When it deviates from its ideal trajectory or the force exerted is not the one required due to some cause, the controller can activate compensating motions and apply a compensating torque according to a predetermined plan to correct this deviation.

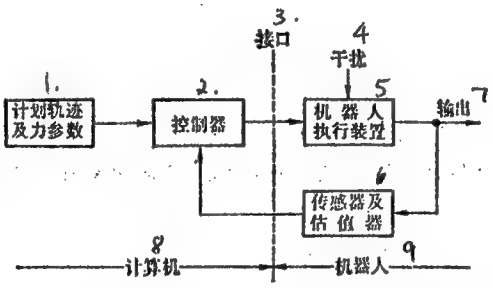

Figure 11. Principle of Robotic Cybernetics

Key:
1. Planned trajectory
2. Controller
3. Interface
4. Interference
5. Robot execution device
6. Sensors and estimators
7. Output
8. Computer
9. Robot

The kinetics of an η degree of freedom robot is described by the η number of strongly coupled nonlinear second-order differential equations. The nonlinearity is due to the inertia load, the coupling of neighboring joints and the gravitational load on the link. In addition, the kinetic parameters of all the components also vary with changing joint positions. These changes are expressed by transformation matrices containing complicated trigonometric functions. All these factors make the design of a robot controller very difficult. In the design of controllers, a number of methods have been developed. Among them the following are most noticeable: RMRC (resolved motion rate control),[14] CMAC (cerebella model articulator controller),[15] near-minimum-time control,[16] computed torque technique[9,10] and adaptivity control method.[17-19] Due to space limitations, only a relatively practical torque calculation method is briefly introduced.

A system designed by torque calculation is basically a front feed system. It employs a PD regulator to impose inertia compensation, gravity compensation and acceleration compensation. The entire system is shown in Figure 12.

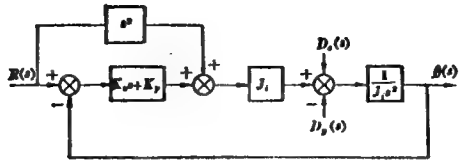

Figure 12. Control System by Torque Computation

In the figure, R(s) is given (the trajectory), $\theta(s)$ is the system's output, J_i is the equivalent moment of inertia of the i-th joint, $D_e(s)$ is the interference torque, D_g is gravity compensation and K_v and K_p are the two regulating parameters of the PD regulator. From the diagram, we can easily find the output (control) of the controller:

$$\tau(s) = J_i s^2 R(s) + J_i(K_v s + K_p)(R(s) - \theta(s)) - D_g(s). \tag{31}$$

If the above expression is in the time domain, R(s) is transformed to $r(t)$ and $\theta(s)$ to $\theta(t)$, and then

$$\tau(t) = J_i \ddot{r}(t) + J_i K_v(\dot{r}(t) - \dot{\theta}(t)) + J_i K_p(r(t) - \theta(t)) - D_g(\theta). \tag{32}$$

From the above formula, the gain J_i is used to compensate the mass inertia of the link. The first term on the right-hand side of the above equation is used to compensate acceleration. The second and third terms are for proportional differential control in order to insure a better response at low static error. The final term is used to compensate the effect of gravity.

In order to obtain the parameters for various parts of the controller it is necessary to link the control patterns with the dynamic characteristics of the system. We have to link Equation (23) to Equation (32) and rewrite Equation (27) as

$$D(\theta)\ddot{\theta} + H(\theta, \dot{\theta}) + G(\theta) = \tau, \tag{33}$$

where $\ddot{\theta} = (\ddot{q}_1, \cdots, \ddot{q}_n)^t$, $\dot{\theta} = (\dot{q}_1, \cdots, \dot{q}_n)^t$, and $\theta = (q_1, \cdots, q_n)^t$, $D(\theta)$, $H(\theta, \dot{\theta})$ and $G(\theta)$ are the corresponding matrices. Equation (32) can also be written as

$$\tau = D_a(\theta)[\ddot{r} + K_v \dot{e} + K_p e] + H_a(\theta, \dot{\theta}) + G_a(\theta), \tag{34}$$

where $e = r(t) - \theta(t)$. If the above two equations are equal, then

$$\left.\begin{aligned} D(\theta) &= D_a(\theta), \\ H(\theta, \dot{\theta}) &= H_a(\theta, \dot{\theta}), \\ G(\theta) &= G_a(\theta), \end{aligned}\right\} \tag{35}$$

Then, $D(\theta)(\ddot{e}+K_v\dot{e}+K_p e) = 0$. Because $D(\theta)$ is nonsingular, $D^{-1}(\theta)$ exists. Therefore, we have

If $$\ddot{e}+K_v\dot{e}+K_p e=0.$$

$$\left.\begin{aligned} &\text{(a) } K_v=K_v{}^t>0, \\ &\text{(b) } K_p=K_p{}^t\geqslant 0, \\ &\text{(c) } \mathrm{Rank}[K_v, K_pK_v, \cdots, K_p{}^{n-1}K_v]=n, \end{aligned}\right\} \tag{36}$$

then $$\lim_{t\to\infty} e(t)=0,$$

As long as conditions (35) and (36) are satisfied, the static error of the system will be zero, which means the system can be controlled and tracked.

It should be pointed out that the torque computation method mentioned above involves a heavy computation load because of the Lagrange-Euler equations. In Reference 10, it was shown that the computer had to perform 2,000 floating-point multiplications and 1,500 floating-point additions when the torque on a joint of the Stanford robot was calculated according to a given trajectory. In Reference 20, the effective Newtonian-Euler equation was used to derive the computation load. The entire computation was finished in 3 milliseconds on a PDP-11/45 computer. However, this method could not clearly express the structure of the dynamic equation. Hence, it does not facilitate searching a set of good control patterns.

FOOTNOTES

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LIFE SCIENCES

OVERVIEW OF DRUG ADMINISTRATION POLICY

Beijing YAOXUE TONGBAO [CHINESE PHARMACEUTICAL BULLETIN] in Chinese
No 10, 8 Oct 84 pp 13-16

[Article by Li Chaojin [2621 6389 6651]: "The Construction of Drug Administration Policy in China"]

[Text] Abstract: This article briefly introduces an account of the development of work in drug administration policy since the founding of the People's Republic of China. It particularly clarifies the development of drug administration work that has occurred since the 3d Plenum of the 11th party Central Committee. The article ennumerates the provisions and measures currently being implemented in China in aspects of drug administration, and also introduces the important work that is taking place in reorganizing pharmaceutical plants, overhaulling the assortment of drugs and strengthening controls over their quality.

In the 35 years since the founding of the People's Republic of China, its socialist drug administration policy has followed a tortuous path to development. In the beginning, bogus and inferior drugs flooded the market, deceptive drug advertisements were publicized everywhere, there were innumerable cases of addiction due to the misuse of narcotics and the situation was chaotic and very serious. In 1950, the Ministry of Health of the central People's Government set up the Drug Administration Organization and made preparations for the establishment of the Ministry of Health's Drug Inspection Institute. Various provinces, autonomous regions and municipalities directly under the central government also one after another established drug administration and drug inspection organizations. With practice, drug administration rules and regulations were gradually drawn up and put into effect. Drug standardization work was launched, examination and approval of drugs was intensified and the inspection and spot-checking of pharmaceutical plant products, drugs sold on the markets and imported or exported drugs was strengthened. Bogus and inferior drugs were suppressed and strict controls were instituted on narcotics and poison superdrugs. Through these efforts, China's drug administration work was initially established. However, during the 10 years of turmoil under the assaults of the ultra-Leftist trend of thought, drug administration was falsely accused of "control and oppression" and it was criticized and severely damaged. The organization was

dismantled, personnel were transferred to other occupations, established and effective drug administration rules and regulations were abolished and drug administration came to a standstill. During that time, unlawful activity such as chaotic management of pharmaceutical plants, the manufacture of drugs in a rough and slipshod way and the manufacture and sale of phony drugs could not be curbed and the guarantees of safe and effective drug use by the people were lost. After the "gang of four" was smashed, and particularly since the 3d Plenum of the 11th party Central Committee, drug administration work has achieved a new life, and drug administration and inspection work has been resumed and intensified. At present, China's drug administration policy has entered upon a new phase of legal management. Under the care of the CPC Central Committee and the State Council, with the support of the departments concerned and through thecooperative efforts of cadres in drug administration and inspection work, tremendous success has been achieved in drug administration work and it has played a positive role in safeguarding the health of the people.

Since the founding of the PRC, drug administration work has been carried on in the following areas:

1. A Series of Drug Administration Regulations and Stipulations has Been Established

As it now stands, we have formulated and put into effect "Drug Administruation Regulations," "Narcotic Administration Regulations," "Regulations for Drug Inspection Institute Work," "Regulations for Hospital Pharmaceutical Work," "Administrative Measures for Drug Standards Work," "Measures for the Administration of New Drugs," "Administrative Measures for the Therapeutic Use of Poison Restricted Superdrugs," "Measures for the Inspection of Imported and Exported Drugs," "Permit Measures for the Import and Export of Psychotropic Drugs," "Provisions for the Conduct of Clinical Drug Trial Studies by Foreign Firms in China," "Provisions for Chinese and Foreign Joint-Capital Start-Ups of Pharmaceutical Enterprises," "Provisions for the Possession of Certificates for Drug Export," "Administrative Stipulations Concerning Radioactive Drugs," "Stipulations Concerning Drug Propaganda Work," "Stipulations for the Basic National Drug Directory," "Administrative Provisions for Biological Products and Blood Products" and so forth. In accordance with State Council instructions and based on a summarization of our drug administration experience since the founding of the PRC, we consulted foreign drug administration laws and regulations and began in 1981 to formulate the "Drug Administration Law of the People's Republic of China," which is currently awaiting ratification. The "Drug Administration Law" incorporates general principles; administration of drug manufacturing enterprises, drug handling enterprises, medical units' pharmaceuticals and specific drugs; drug packaging and sub-packaging; drug advertisement administration; drug supervision; legal responsibility and supplementary articles.

When it is ratified, promulgated and implemented, the Drug Administration Law will mark the entrance of China's drug administration work into a new phase of rule by law. Its implementation will certainly further advance drug production development and quality improvement in China. it will not only enable us to attain for the people further assurances of safe and effective drug use, but it also is certain to raise enormously the status of Chinese drugs on the international market and strengthen their ability to compete in international trade.

2. Intensification of Drug Standardization Work

Drug standardization is the technical provision made by the state for drug quality specifications and inspection methods. It is the legal basis for common compliance by departments of drug production, handling, application, inspection and administration. China's work in drug standardization began to move forward with the founding of the PRC, and it is being perfected step by step in the wake of development in medical production. Drug standards are currently divided into Chinese pharmacopeia standards, standards issued by the Ministry of Health and drug standards for provinces, autonomous regions and municipalities directly under the central government. As early as 1950, the Ministry of Health had established the Committee to Compile a Pharmacopeia of the People's Republic of China, which to date has published three editions of the pharmacopeia.

The 1953 edition of the pharmacopeia recorded 531 drug standards and 58 general rules for preparations and inspection methods, but it did not record traditional Chinese medicine. In 1957 the Pharmacopeia Committee was reorganized and in 1963 it published the second edition of the pharmacopeia, recording 446 standards for traditional Chinese medical materials, 197 kinds of Chinese proprietaries and 667 kinds of western drugs. In 1977 the third edition of the pharmacopeia was published, in which a total of 1,925 kinds of drugs and preparations of all kinds were recorded, folk medicine was added, the components of some variety standards were revised and the sources of some plant varieties were clarified. With respect to the differentiation of genuine from false traditional Chinese medical materials, microscopic, physical and chemical methods of differentiation were stipulated for 400 varieties and 202 Chinese proprietaries, respectively. This edition of the pharmacopeia records 773 kinds of chemicals, medical isotopes and biologicals. As for inspection methods, in addition to the use of high-precision, simple and convenient methods, it also applied some new techniques. After the "Cultural Revolution," the Ministry of Health in 1979 reestablished the Pharmacopeia Committee, and at present it is compiling a new, rigorously edited and revised 1985 edition of the pharmacopeia. At the same time as pharmacopeia work was being stressed, work on minitry-issued drug standards was also augmented. The 1963 edition of the "Drug Standards Issued By the Ministry of Health" recorded 176 Chinese and Western drug standards; in 1972 the ministry-issued standards on antibiotics were published; in 1975 12 medical isotope standards were

formulated; in 1979 "Drug Health Standards" and quality standards for 54 southern drug imports were drawn up. The various provinces, autonomous regions and municipalities directly under the central government also one after another formulated "Local Drug Standards."

3. The Institution of Drug Quality Control Supervision

These are important measures taken based on drug standards to conduct supervisory assessments of the manufacture, handling and use of drugs and to promote improved levels of quality, medical safeguards and administration. In the early period after the founding of the PRC, in order to counter the existing situation of multiple drug-importing systems, the emphasis of drug inspection was on strengthening the supervision and inspection of imported drugs (according to incomplete statistics one-third of the drugs at that time were not up to standard). Simultaneously, substandard drugs were prevented from entering the country, economic losses to the state were avoided and the people were assured of safe and effective drug use. Following in the wake of pharmaceutical industry growth in China and the establishment of drug inspection institutes at all levels, quality control was strengthened over products prior to removal from the plants, the occurrence of quality mishaps was effectively prevented and the quality of goods leaving the factories was guaranteed. In conducting quality inspections, drug inspection institutes at all levels adhered to the principle of combining administration with assistance, inspection with fact-finding research and specialized inspections with mass quality control. Drug inspection personnel left their laboratories and infiltrated drug manufacturing units, drug handling units and hospitals to conduct spot tests, and when they discovered problems they solved them promptly. The establishment of county-level drug inspection institutes intensified quality control over drugs in rural areas, coordinated with the departments concerned to strengthen quality control over drugs in the marketplace, attacked the illegal activities of lawless roving medicine peddlers who made and sold bogus drugs to trap the masses, banned phony and inferior drugs and safeguarded the interests of the masses.

Quality demands on biologicals are even more rigorous. Gross annual output of the more than 100 varieties of biologicals produced in China is enough to supply several hundred million people. Due to the possession of effective biologicals, we have been able to gain control over some contagious diseases an eliminate them. Verification work on the quality of biologicals has continuously advanced and improved along with the development of biologicals. In 1982 a comprehensive reorganization of beiologicals was conducted, certificates of quality were reissued and production was approved.

4. Administration of Narcotics and Psychotropic Drugs Was Tightened, Their Unlawful Manufacture, Sale and Abuse Was Stopped and Social Stability and the People's Health Were Safeguarded

Morphine, opium, dolantin and other narcotics are drugs that are indispensable in medicine, but they are of a dual nature: when used properly they can prevent and control illnesses, but when used improperly, without supervision, they cause people to become addicted and endanger their health. Since the founding of the PRC, our policy of intensified narcotics supervision has been closely linked with the struggle to clean up opium smoking. In 1950, the Government Administration Council promulgated a "General Order on the Method of Prompt Registration and Disposition of Narcotics." At the same time, it issued "Regulations for Narcotics Administration" and detailed rules for their implementation. These clearly stipulated the government appointment of a specialized pharmaceutical plant to be responsible for narcotics manufacturing. The China Pharmaceutical Company was appointed to supply the task and all other organizations and individuals were prohibited from private cultivation, manufacture or peddling of narcotics, with violators to be punished according to law. There also are specific stipulations concerning the purchase and use of narcotics by medical units. For many years now, due to strict control and administration, we have ensured that the needs of medical and scientific research are met, and we have prevented abuses, put an end to corrupt practices and received enthusiastic support from the Chinese people and just praise from the rest of the world.

The abuse of psychotropic drugs has created a dependence in certain people, and in 1964 the Ministry of Health formulated its "Method for Administration of Poison Superdrugs." In 1979, in conformance with the stipulations of the "Drug Administration Regulations," the Ministry of Health revised and reissued its "Method of Administration of Poison Restricted Superdrugs in Medical Usage," and made specific stipulations regarding requirements for their manufacture, compound formation, sale and quantity limits. In the past 10 years, the abuse of narcotics and psychotropic drugs has become a serious social problem in many countries. People, public opinion and government organizations in every nation are all very concerned about the dangers involved and actively participate in the United Nations' "Convention on Narcotics Drug" and "Convention on Psychotropic Drugs." For the past several years, the United Nations General Assembly has many times passed resolutions calling on all nations to participate in signing the convention. In order to strengthen cooperation with the International Narcotics Control Board, China has many times sent observers to attend the conference of the United Nations' Commission on Narcotics Drug. At these conferences we have introduced China's administrative policies on narcotics and psychotropic drugs, for which we have received the serious attention of the conferences and the praise of the conference delegates. At present we are making preparations to participate in the convention. In order to cooperate and support the international control of psychotropic drugs, in 1983 the Ministry of Health and the Ministry of Foreign Affairs issued an import/export permit system on 40 kinds of psychotropic drugs. In addition, in cooperation with the World Health Organization, they established the Drug Dependency Research Center in China to strengthen scientific research work.

5. Nationwide, We Have Launched Work to Overhaul Pharmaceutical Plants, Drug Varieties and Hospital Preparations

In 1961 the Ministries of Health, Chemical Industry and Commerce implemented policies to reorganize, consolidate, enrich and improve the central authorities, and carried out the first overhaul of pharmaceutical plants. The central authorities approved the stationing of a resident representative in 17 large pharmaceutical plants to take special responsibility for quality control work. During the 10 years of turmoil, due to the relaxation of drug administration, chaotic management in pharmaceutical plants and rough and slipshod drug manufacturing were very serious everywhere. In June 1979, the State Council approved and transmitted a "Report on the Launch of Nationwide Pharmaceutical Plant Reorganization Work" of the Ministry of Health and other ministries and commissions. The Ministry of Health, the State Bureau of Medical Administration and other units immediately organized the Pharmaceutical Plant Reorganization Leadership Group, and the concerned departments of the various provinces, autonomous regions and municipalities directly under the central government also formed corresponding work organizations under the unified leadership of their local governments. Through investigations of the real situation and through the conduct of pilot projects, they formulated concrete reorganization requirements and detailed implementation rules, and carried out overall reorganization of drug manufacturing units nationwide. They closed, suspended, merged or retooled several hundred "pharmaceutical plants" that were not in conformance with pharmaceutical plant requirements and issued certificates to more than 1,800 plants that passed the examination and were accepted. Through this reorganization, they intensified production administration, transformed factory appearances, established a civilized production sequence, replenished quality-inspection personnel and established and perfected a trial-level quality inspection network to provide a certain assurance of product quality.

Simultaneous with pharmaceutical plant reorganization, the health offices (bureaus) of the various provinces, autonomous regions and municipalities directly under the central government launched work to overhaul drug varieties. They conducted a complete inventory of the western and traditional Chinese drugs manufactured in their regions, recorded and reexamined items one by one, reconducted examination and approval procedures and issued new documents of ratification. At present we produce more than 800 kinds of drugs from western medical materials and 2,000-plus kinds of western drug preparations in more than 20 forms. Of these, there are 500-plus kinds of injections, 800-plus kinds of tablets, 140-plus kinds of ointment preparations, 130-plus kinds of liquid preparations, 80-plus kinds of glucose serum preparations, 100-plus kinds of capsules, nearly 30 kinds of pills, 30 kinds of film preparations and 70 kinds of powders. There are a total of 5,200 kinds of Chinese proprietaries in forms including pills, powders, dococtions, plasters, spirits, colloids and so forth.

In the reorganization of drug varieties, appraisal of clinical effectiveness was combined with pharmacological and toxicological research, and, on the basis of widely solicited opinion, those varieties which were not definitely effective or which had major toxic side effects were eliminated. In September 1982, the Ministry of Health announced the elimination of 127 varieties.

In order to strenghten administration of hospital preparations, the Ministry of Health issued the "Comprehensive Scientific Hospital Preparation Work System and Personnel Responsibilities" in March 1958, and in April 1981 it further issued Work Regulations for Hospital Preparations." In order to implement these regulations, reorganization work was launched on hospital preparations nationwide and has already been examined and accepted by turns. Where conditions were up to standard, permits for ordinary preparations or sterile preparations were granted, and where conditions were not up to standard, qualifications for compound preparations were revoked. In the process of reorganization, many hospitals improved their medical level by replenishing their technical forces, improving environmental conditions, adding to their testing apparatus, establishing rules and regulations, refraining from clinical use of nonstandard preparations, greatly changing the face of their dispensaries, improving working conditions and increasing the work initiative of preparations personnel. Clinical pharmacy work also began to flourish and develop into a gratifying state. Clinical pharmacy is a science that researches reasonable, effective and safe drug uses for patients. For the past few years, due to the efforts of the broad mass of preparations personnel, in many hospitals the medical personnel begin from the examination, prescription and case history and acquaint themselves with the questions involving drug use in that unit. Then, through analysis they put forward an opinion as to reasonable drug use, cooperate closely with the doctors and decide through consultation on a program of drug use. As a result, they have improved the quality of medicine and are welcomed by doctors and patients. Some hospitals with better technical facilities have also established clinical pharmacy laboratories, launched drug pharmaceutical monitoring work and provided a scientific basis for clinical drug use--in addition to working out the optimum drug use program. Some medical personnel also work in coordination with doctors, combining clinical and pharmacological work to conduct tests and observations of the curative effects and unfavorable reactions of new drugs or new drug forms. This has provided scientific data for the approval of new drugs and the reevaluation of old drugs.

For the past few years, under the guidance of policies lifting restrictions on external contacts, China's technical exchange activities with many other countries have expanded rapidly. With respect to drug policy, we have carried on contact with departments of drug administration in many other countries. In conformity with the technical cooperation agreement between the Ministry of Health and the World Health Organization, we have many times dispatched study groups to Japan, the U.S., England, Sweden, Thailand, the Phillipines, Singapore and other nations to conduct

investigative research on their pharmaceutical and clinical evaluations, regulations for the approval of new drugs, stipulations on drug standards, drug quality control personnel systems, systems of reporting toxic side effects of drugs, drug manufacturing standards and other drug administration work. Their many regulations and methods are very valuable references for us. This kind of friendly exchange activity has promoted mutual understanding between China and the drug administration departments of various other nations of the world. It has developed friendship, expanded China's influence and at the same time been enormously beneficial to the development of our drug administration work.

For the past 35 years, drug administration and drug inspection work have made a certain contribution to assuring safe and effective drug use for the people, protecting the health of the people and developing China's medical and health facilities. Currently, the work emphasis of the CPC has shifted to modern construction, and medical science is moving forward and changing with each passing day. In order to be compatible with the demands of new circumstances and tasks, drug administration and inspection work must proceed from China's national conditions and take the road to Chinese-style, socialist drug administration. The burden is heavy and the road is long, but if all comrades in drug administration and inspection work support the four basic principles and, in accordance with the itinerary of the 12th Party Congress, pay attention to constant summarization of their experiences, are adept at arousing initiative in all areas, inspire revolutionary enthusiasm, are bold in reforms and innovations, study hard and continuously raise the quality of scientific supervision, then we can certainly continue to raise the level of drug administration work and make a new contribution to the four modernizations.

12510
CSO: 4008/152

LIFE SCIENCES

SHANGHAI HOSPITALS WORK TO BATTLE TUMORS

OW161816 Beijing XINHUA in English 1545 GMT 16 Mar 85

[Text] Shanghai, March 16 (Xinhua) -- Hospitals in Shanghai's eight districts have formed a preliminary network for the prevention and treatment of tumors.

In China's leading industrial city 58 hospitals have conducted general gastroscopies on 16,928 persons for cancer of the stomach, which is of frequent occurence here.

They found 6,000 cases of cancer in various stages of development, but the timely operations which followed resulted in complete recoveries for many sufferers.

Zhongshan Hospital, which has been using a-fetoprotein (afp) analysis, has raised the survival rate of patients with their earlier-stage foci removed by 72.9 percent from the previous 16.1 percent.

Similar coordinated methods for prevention and treatment of cancers of the lungs, intestines and the breast are showing marked results.

The tumor control institute of the Yangpu district has set up a tumor prevention and treatment network in conjunction with the district's factory clinics, and trained 120 doctors for general check-ups at grass-roots organizations.

About 140,000 people in 84 factories are being monitored by the hospital.

8663
CSO: 4010/103

LIFE SCIENCES

HOME NURSING BEATS HOSPITALIZATION RECOVERY

OW120137 Beijing XINHUA in English 1441 GMT 11 Mar 85

[Text] Chongqing, March 11 (Xinhua) -- Retired senior engineer Chen Xiaocheng, 60, used to stay in hospital for the whole winter because of recurrence of asthma.

But last winter he stayed at home, visited regularly by doctors.

"It is more comfortable here than in hospital," he said. "And I hope to recover quicker from my long years of suffering."

"Chen is one of the more than 11,000 patients who have received treatment at their homes over the last six months in this Southwest China city, where economic reforms are being tested.

Treating patients in their homes, which is referred to as "establishing home hospital beds" in China, is only a recent innovation, designed to ease strains on hospital beds, which are available in limited numbers.

Now the practise is spreading to many big and medium-sized cities suffering from the same problem.

Patients treated in their homes are mostly old people suffering from serious chronic diseases, or handicapped people unable to go to hospitals.

According to a survey of 159 bedridden people conducted by the Chongqing No. 3 People's Hospital, 79 percent of such patients are over 50 years old.

The general reaction is that patients receive better care and food at home than in hospitals, and recover faster.

Usually, home treatment cuts medical costs by half for patients not covered by the state free medicare program; for those covered by the program, only travel expenses are paid, which amount to not more than one yuan (about 40 cents U.S.) per visit.

8130
CSO: 4010/103

LIFE SCIENCES

XIZANG PUBLISHER RELEASES PLATEAU SICKNESS PAPER

OW151030 Beijing XINHUA in English 0651 GMT 15 Feb 85

[Text] Ihasa, February 13 (Xinhua) -- The Tibet People's Publishing House recently announced publication of "Practical Medical Treatment of Plateau Sickness."

The medical treatise was compiled by 45 doctors of Tibetan and Hen nationalities, most of whom have worked for 20 years or more in the Tibetan highlands, 4000 meters above sea level. The editor in chief is Wang Dingqin, 63, former director of the regional people's hospital.

The treatise covers such subjects as the effect of the scarcity of oxygen on the human body, how the body adapts to the high altitude, the pathogenesis of plateau sickness, how it can be prevented and treatment.

Also discussed are common, endemic and parasitic diseases of the highland. The book introduces the use of traditional Tibetan and Chinese medicine in treating plateau maladies.

8355
CSO: 4010/103

LIFE SCIENCES

HEALTH MINISTRY ENCOURAGES CARE OF AGED

OW121224 Beijing XINHUA in English 1214 GMT 12 Mar 85

[Text] Beijing, March 12 (Xinhua) -- The Ministry of Public Health today urged the whole society to become involved in taking care of aged people.

China had 80 million people over 60 years old, accounting for eight percent of its total population in 1980. This number will increase to 130 million by the end of this century, or 11 percent of China's population.

It is an urgent matter to offer better health care for these people, the ministry said, as the present services are quite inadequate, the ministry said.

The ministry called upon medical departments throughout China to take steps to prevent and treat frequently encountered diseases of the aged, conduct an epidemiological survey and teach old people how to keep fit and prevent diseases.

Hospitals at or above the county level should open special clinics for the aged, and priority will be given to old people in seeking medical advice in every hospital, the ministry noted.

The development of the geriatric prescriptions of traditional chinese medicine should be pursued and persons of ability trained in this field.

CSO: 4010/103

LIFE SCIENCES

BRIEFS

BEIJING HEMOSTATIC MEDICINE--Beijing, 18 Jan (XINHUA)--The Beijing No. 1 Biochemistry Pharmaceutical Plant successfully used pig's blood to produce a hemostat, which is 97.2 percent effective in stopping local bleeding. Currently, cogulative enzyme produced abroad uses cattle or human blood. [Summary] [Beijing XINHUA Domestic Service in Chinese 0925 GMT 28 Jan 85 OW]

UN AID TO GUANGXI--With the consent of the Ministry of Foreign Economic Relations and Trade and Through the arrangements of the Ministry of Public Health, the United Nations Children's Fund and the United Nations Fund for Population Activities have financially aided Guangxi Region to build Yangshuo and Wuming Counties, the Regional Health Clinic for Women and Children, and Liuzhou City respectively into points to demonstrate health work for women and children, a maternity and child care training center, and a final-stage prenatal examination demonstration point. Demonstration of health work for women and children in Yangshuo County began in 1982. Building Wuming County into a county to demonstrate health work for women and children and of the regional Maternity and Child Care Training Center will begin this year. These three projects have been carried out in cooperation with the United National Children's Fund. The Liuzhou City Final-stage prenatal examination demonstration point is a project carried out in cooperation with the United Nations Fund for Population Activities and already commenced work in 1983. [Summary] [Nanning Guangxi Regional Service in Mandarin 1130 GMT 28 Feb 85 HK]

HEART DISEASE IN HUNAN--Out of 10,000 people examined in Hanshou County, Hunan Province, 81 suffer from congenital and rheumatic heart disease, the Chinese specialist journal, HEALTH NEWS reports. During a survey sponsored by the local health bureau, doctors conducted examinations in three middle schools and 18 villages. Half of the patients thus diagnosed had been unaware of having heart disease. Most were school students and people under 45. The aim of the survey was to both prevent and treat heart disease. According to a government health survey last year, heart disease, cardiovascular disease and cancer are China's three main killers. [Text] [Beijing CHINA DAILY in English 7 Mar 85 p 5 HK] 6971

CSO: 4010/103

ENVIRONMENTAL QUALITY

NATIONAL ENVIRONMENTAL PROTECTION CONFERENCE HELD

Environmental Conference Reported

Beijing ZHONGGUO HUANJING BAO in Chinese 26 Jan 85 p 1

[Text] On the National Conference on Environmental Protection Work, convened on 22 January, the central topic of discussion was how to open up a new state in our country's environmental protection work in line with the situation of reform which centers around the reform of the urban economic system.

Rui Xingwen [5360 2622 2429], minister of urban and rural construction and environmental protection, delivered an important speech at the opening ceremony. He stressed that, in environmental protection work we must catch up with the situation of the reform, emphasize well the implementation of environmental protection laws, strengthen environmental management and raise our awareness of our environment (excerpt from his speech is carried separately).

Qu Geping [2575 2706 1627], head of the Office of the Environmental Protection Commission of the State Council and head of the State Environmental Protection Bureau, summed up the tremendous progress which our country had made in the environmental protection work in the past year, and proposed new tasks for this year.

Comrade Qu Geping said: In 1984, our country has made relatively great progress in the establishment of environmental protection agencies, has basically smoothed and opened up the channels of funding for environmental protection, has formulated several environmental protection laws and policies, has solved a number of most prominent environmental problems which most concerned the masses, and has raised the awareness of the whole nation toward our environment. He said, through the common effort of all the comrades on the environmental protection front and the vigorous support of the various trades and undertakings throughout the country, last year, over 70 cities throughout the country have succeeded to a certain extent in controlling noise pollution by generally lowering the noise pollution from traffic in the cities by 3 to 7 db. In Guangdong Province, eight cities have lowered their noise level by 6 to 7 db; in Xian City, by 9 db; and in Luoyang City, by 6.8 db. In Hangzhou City, last year, over 40 units have controlled the noise pollution from machines, and over 1,000 residential households no longer had to suffer from noise pollution.

Many cities have made relatively great progress in controlling air pollution. Over 70 cities, including Beijing, Shanghai, Tianjin, Ulumuqi and Hangzhou, have realized central heating in some urban areas, thereby effectively reducing the air pollution caused by burning coal. Some scenic areas and busy urban areas of Beijing, Shanghai and Hangzhou have even become "sootless areas."

Some cities have made relatively great improvement in controlling the key sources of pollution. Beijing, Tianjin, Kunming, Haerbin, Dalian and Yichang have all emphasized the work of controlling the key sources of urban pollution, and have closed down, stopped the production of, merged, converted or relocated those enterprises with serious pollution problems which were difficult to control. Last year, in Beijing Municipality, 14 factories and workshops with serious pollution problems were closed down and production stopped, and 100 electroplating factory outlets were removed. In Tianjin Municipality, 13 enterprises with serious pollution problems and without the factors for controlling them were moved out of the urban area. In Chongqing City, 11 enterprises with noise pollution and dust pollution were treated. Treatment was carried out in varying degrees on nearly 30 rivers and over 10 lakes which were polluted. The environmental protection departments of Hebei Province and Tianjin Municipality have strengthened the work of protecting the water quality that was being channeled into Tianjin from the Luan He. Those factories on the west bank of the Luan He which were polluting the river water have begun to be treated or relocated. Beijing Municipality has treated the Wanquan He and the Beihucheng He, turning the previously turbid water into clear water.

Rui Xingwen's Speech

Beijing ZHONGGUO HUANJING BAO in Chinese 26 Jan 85 p 1

[Excerpt of speech by Minister Rui Xingwen at the National Conference on Environmental Protection Work: "Launch Well the Environmental Work in the Midst of Promoting Economic Development"]

[Text] Godd results have been attained in the environmental protection work last year. This is the result of our common effort. On behalf of the party organizations, I extend our congratulations and our regards to our comrades and to the broad masses of staff members and workers on the environmental protection front throughout the country. Currently, the people all over the country are actively studying and implementing the "Decision on the Reform of the Economic System" by the central authorities. Under such a situation, how should we launch our environmental protection work? What attitude should we adopt?

Environmental Protection Work Must Conform to the Situation of the Reform.

The "Decision on the Reform of the Economic System" by the central authorities is an important decision since the 3d Plenary Session of the 11th party Central Committee. The core issue in the reform of the economic system is to discover a vital and vigorous economic system for our country. Our goal is to revitalize the economy and enable the productive forces to become highly developed.

Our environmental protection work must serve and obey this goal. In carrying out a reform of the system that suits the Chinese situation. This basic model is a planned commodity economy with the system of public ownership as the basis. Here, we have a fundamental theoretical problem: How can the system of public ownership practice a commodity economy? This means, we must distinguish the right of ownership from the right of management. The means of production are owned by all people, but the right of management can belong to the collective or the individual. The business, good or bad, is directly linked to the interest of the unit or the individual. This will basically solve the problem of the "same big pot." The most fundamental achievement scored in the reform in the rural areas is the separation of the right of ownership and the right of management. The rural areas have done so for several years. The urban and rural economy has become more and more vigorous. With the development of our economy, industry must be transferred to the rural areas, and a large number of labor forces in the rural areas must become involved in industry, commerce, transportation, building construction and service trades. The medium-sized and small cities and towns will develop on a larger scale and more rapidly. Under such an excellent situation, our attitude must be clear: First, we must actively support the reform of the economic system and promote the development of the urban and rural economy. We should be able to realize that, if we fail to develop our country's economy, we will fail to make our country strong and will likewise fail to promote our environmental protection work. We must embrace this concept of regarding the situation as a whole. Second, we must fervently guide the urban and rural economic construction, explain the principles for doing so clearly, make more suggestions accordingly, and make everyone understand all the harmful consequences of pollution. Third, we must persevere in taking preventive measures. If we do not pay attention to urban industrial pollution, we will suffer greatly in the future. We must establish our foothold on prevention. This is our duty. If we do not emphasize this, then we are neglecting our duty. Our bounden duty in environmental protection work is to protect the environment.

This major change has been very beneficial to our environmental protection work. Recently, I visited some large cities, and saw a very bit change everywhere in the work of implementing the "Decision" and of carrying out reform, and that was: The municipal people's government has emphasized primarily urban construction and management as well as environmental improvement; and the municipal financial expenses were primarily used in the building of urban infrastructures. The municipal government no longer financed the industrial and communications enterprises, which had to rely on loans. Another favorable factor was the separation of government and enterprise. After the power of the enterprise has been expanded, the vitality of the enterprise has been increased. In the past, there was no flexibility in controlling the enterprises with pollution problems. Since these enterprises all ate out of the "same big pot," wages were drawn all the same although production was stopped. Now that the enterprises have implemented economic accounting, the situation has become vastly different. When a factory stops production because of pollution, the staff members and workers will not be agreeable. They will say that this factory head is a head for closing down factories, and will ask this person to resign at the next staff members' and workers' congress. Thus, when the environmental protection department exercises control, the enterprises will all

do their best to treat pollution, since there will be no future if the problem is not treated. We must actively participate in this big change, and launch well the environmental protection work in this reform.

The Basic Methods of Work in Environmental Protection.

What are the basic methods of work in environmental protection? Thinking about this over and over again, I have come up with three basic methods: The first one is to rely on law; the second one, on management; and the third one, on raising the awareness of the masses of people toward the environment. These three methods will bring along others. The awareness of the environment by all people is the basis for doing the environmental protection work well. If the masses are not aware of or do not understand the issue, then we will not be able to do our work well. Thus, we should strengthen propaganda and education. After the separation of government and enterprise, we should primarily rely on management by law. Law refers to the various kinds of environmental protection laws issued by the state. When there is law, there is something for people to go by, and something for us to go by in launching work and strengthening management. Of course, having just laws is not enough. We must have people to implement them. Laws which are not implemented are nothing but a mere scrap of paper. Thus, we must emphasize the word "management," and must concentrate our effort on management. We did have management in the past, although its role was sometimes small. This was related to our system of organization. After the reform of the economic system, the business, good or bad, of an enterprise is directly linked to the interest of the enterprise itself as well as the individual interest of the staff members and workers. The "same big pot" has been shattered, and our management has accordingly become effective.

Erect a Style of Doing Work Practically.

We must give prominence to the spirit of doing work practically, and must not play tricks. If we put up a glamorous show without solving any problem, the masses will be dissatisfied. The masses of people mainly want to see our ability, efficiency and result in work. Recently, I visited several cities. What created the most profound impression on me was that the several mayors have greatly strengthened their spirit of doing work practically. In the past, in reporting their work, many mayors would talk about hats and boots and then a lot of irrelevant matters. One did not have any idea what was actually done. Now, in making reports, the mayors no longer talk in the above manner. They all talk about the several things which they will carry out in their term of office, and indicate that they will voluntarily resign if these matters are not done. Some will build gas companies, others will build sewage plants, and still others will build a few vertical cross bridges. In short, their spirit for doing work practically has been much improved over the past. We must advocate this spirit, Comrade Li Peng [2621 7720] emphasizes environmental protection work. He convenes a quarterly conference to talk about several practical matters to be done. The spirit of doing work practically must first of all be advocated by our environmental protection departments and must also be continually promoted in our environmental protection work. As long as we propose several practical matters in line with our local financial

resources, material resources and the masses' demands, these matters will be regarded with importance by the masses and will not be scorned. We have backing and the support of the masses. A mayor must be responsible to the masses of people and to the people's congress, and must do his work practically. Thus, we should advocate the spirit of doing work practically, handle several practical matters conscientiously every year, and regard this as our basic style of work.

9335
CSO: 4008/226

ENVIRONMENTAL QUALITY

BEIJING INCREASES EFFORTS TO REDUCE POLLUTION

OW271558 Beijing XINHUA in English 1441 GMT 27 Feb 85

[Text] Beijing, February 27 (Xinhua) -- Digital displays monitoring air and noise pollution will soon be set up on busy Qianmen street south of Tiananmen square, and in two major shopping districts, according to Beijing's vice-mayor, Zhang Baifa.

Zhang was speaking at a working conference on environmental protection which opened here today.

China's capital made great strides in controlling pollution last year by completing 12 projects in this field, Zhang said. Among the highlights of these achievements are the fact that Beijing is now able to treat 43 percent of industrial waste water -- as compared to only 38 percent a year ago -- and traffic noise on the main thoroughfares has been reduced from 76.7 decibels to 69.3 in the same period.

Another 12 projects to be completed this year include cleansing of five scenic lakes to the north of the palace museum and their surrounding areas, and further controls on sewage discharge, soot and noise.

The environment will be further purified, he explained, when another 100,000 families are supplies with piped gas for cooking and abandon coal burners this year. This will mean that a total of 930,000 Beijing households will be using gas by then.

The vice-mayor continued that 111 pollution-causing factories will be given deadlines to modify their equipment, move their locations, shift to other lines or close down. Some 40 electroplating workshops will be merged with other units, he said.

Zhang made an appeal for further efforts to enhance the city's environmental-protection campaign with the help of advanced technology.

8221
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ENVIRONMENTAL QUALITY

SWEDISH INSTITUTE AIDING TO CLEAN UP MERCURY IN SONGHUA JIANG

Stockholm SVENSKA DAGBLADET in Swedish 22 Feb 85 p 27

[Article by Lennart Lundegardh]

[Text] China has been hit by a serious mercury catastrophe. This occurred in a region near the town of Changchun in the northeastern section of the country. Emissions from factories have poisoned the Songhua River.

Swedish experts are participating in the effort to eliminate damage from the accident. So far, the Chinese have been unwilling to indicate the extent of the damage.

The pollution was discovered 3 years ago and, at that time, a Chinese delegation was sent to the Swedish Institute for Water and Air Pollution Research (IVL) in Stockholm to gather as much information as possible on this type of threat to the environment (previously unknown in China).

It was natural for the Chinese to turn to this institute. Swedish researchers had observed the problem of mercury in the environment at an early stage. In addition, there is a cooperative agreement between the Chinese Academy of Sciences and the Royal Swedish Academy of Engineering Sciences (IVA).

Visited Region

The chief researcher at IVL at that time, Arne Jernelov, was assigned to the task and has visited the affected region several times. Now he is able to tell SVENSKA DAGBLADET about the incident.

"For various reasons, the Chinese have been unwilling to publicize the incident. Now, however, there is a Swedish-Chinese agreement on cooperation in finding solutions to common problems. After all, Sweden also has a mercury problem," he said.

The United Nations environmental protection organ, UNEP, will serve as an umbrella organization for the continuing effort to save the Songhua River.

Changchun is in a remote section of China that extremely few Westerners have visited in recent years.

The emissions came from chemical and metallurgical plants that began to be constructed during the 1950's, with the assistance of Russian technicians. Since then, there has been a rapid expansion in the typical Chinese manner of copying existing facilities in great numbers with practical no changes or technological advances.

Chloralkali Factories

Among these plants were chloralkali factories that release mercury along with their waste water. Thus, this is the same type of problem that arose at Swedish facilities. In Sweden, however, the problem was discovered long before serious injuries could result.

"Mercury levels of 7 to 8 mg/kg have been found in large fish of prey in the Songhua River," Arne Jernelov said. In Sweden, the limit for blacklisting a body of water is 1 mg/kg of fish flesh.

"When the Chinese discovered what had happened, they immediately closed the factories and prohibited all fishing," he continued. But this did not eliminate the problem.

Mercury has accumulated in sediment banks in the river bed of the Songhua. It is estimated that there are about 150 tons of the toxic metal, which continually leaks out into the water and is taken up by fish and other organisms.

Migrating Poison

The sediment banks migrate downstream with the current. The dangerous accumulation of mercury migrates 50 to 100 km each year.

"This means that more and more new regions are affected. Unfortunately, more and more people live in the regions downstream," Arne Jernelov said. The people who live in rural areas of China are highly dependent on fish as a source of protein.

Many different measures have been discussed to solve the problem, including excavation of an entirely new river bed for the Songhua River. This proved to be impossible, however, for geographic reasons.

Other proposals include binding the mercury with the element selenium or constructing temporary sediment basins.

"It could be possible to exempt certain types of fish from the prohibition," Arne Jernelov said. "As we know, fish of prey have higher mercury levels than other species and large fish have higher levels than small fish."

It is difficult to say, however, whether or not such recommendations would work. How would it be possible to disseminate the information?

"A research program will soon begin. This is a joint Swedish-Chinese matter," Arne Jernelov said.

He has previous experience with such an "emergency mission" involving a mercury catastrophe. During the early 1970's he was sent to Iraq.

At that time, thousands of people were poisoned by mercury-impregnated seed that had been sent to Iraq for relief purposes. The seed was delivered to the farmers at the wrong time of year. The people were unaware of the danger and they baked bread with the meal, thereby sustaining serious injuries.

People Must Have Been Injured

Have people been injured by the mercury emissions in the Changchun region?

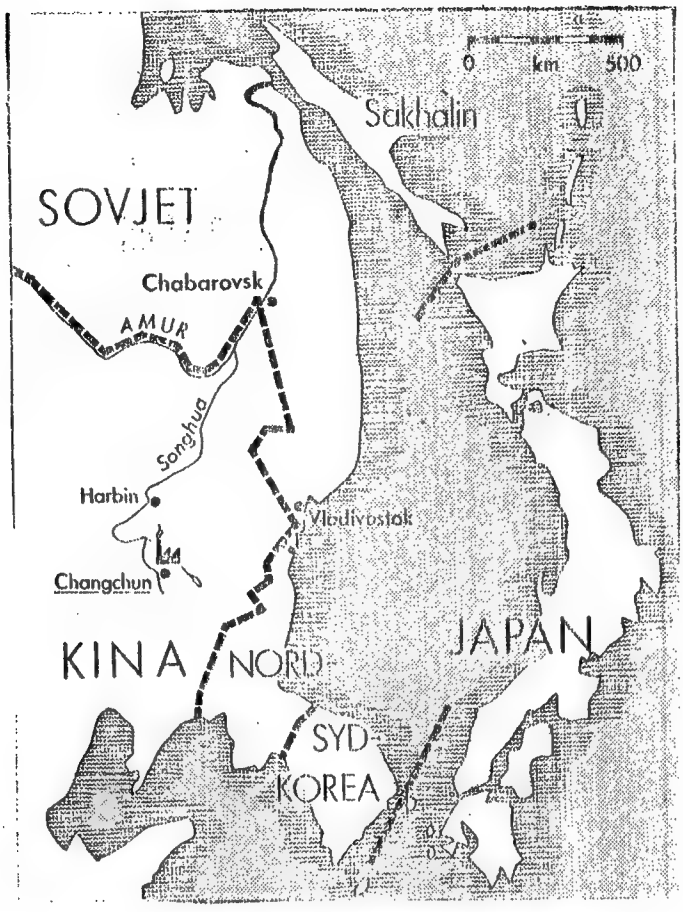
So far, the Chinese have been unwilling to say and Arne Jernelov has respected their wishes, but the extent of the emissions, the long period of time that has passed, the measured levels in fish, and the consumption pattern indicate that personal injuries simply must have occurred.

This is also indicated by the sudden closing of the plants and the prohibition against fishing.

A glance at the map indicates, however, that there also may be international consequences if the migrating mercury cannot be stopped in time.

The Songhua River runs northeast and flows into the Amur River on the Soviet boundary! Thus, there is the danger that the powerful neighbor to the north also will be affected by the mercury pollution.

The Amur flows into the Sea of Okhotsk. If the pollution reaches that far, it will endanger Kamchatka crabs, which are exported around the world.



Sediment banks in the Songhua River containing 150 tons of mercury have migrated from the Changchun region to the town of Harbin. On the other side of the border is the Soviet city of Khabarovsk.

9336
CSO: 3650/189

ENVIRONMENTAL QUALITY

NINGXIA'S AGRICULTURAL ENVIRONMENT DISCUSSED

Agricultural Environment Symposium

Yinchuan NINGXIA RIBAO in Chinese 14 Dec 84 p 1

[Text] The scientific and technological workers of the autonomous region raised a cry of warning: The agricultural ecological environment of our region has suffered destruction of varying degrees. Some problems are quite prominent. We must strengthen the work of protecting the agricultural ecological environment in order to meet the needs of our agricultural and economic development.

At the regional symposium on protecting the agricultural ecological environment, held in Zhongwei County from 2 to 5 December, the scientific and technological workers pointed out that: Since the nation's founding, our region has made tremendous development in agricultural production and scored great achievements accordingly. However, we have done many foolish things in violating the law of nature, and have brought about destruction to the agricultural ecological environment. We are faced with the following rather prominent environmental problems: 1. Due to the destruction of forest coverings, water and soil loss resulted. Over 30,000 square km of land throughout the region are suffering from water and soil loss. They constitute nearly half of the total land surface of the entire region. Every year, over 84 million tons of silt were discharged into the Huang He, resulting in a loss of fertile soil and increased burden on the Huang He. 2. Due to indiscriminate land reclamation, indiscriminate digging and indiscriminate cutting down of vegetable resources, the area covered by desert in the entire region has continued to expand, and has reached some 25 million mu, constituting one-fourth of the total land surface of the entire region. 3. Due to our negligence of the objective factors and of science, we permitted excessive grazing and indiscriminately dug up and picked vegetable resources. As a result, the pastoral areas were destroyed, the quality of the pastures was lowered, and output was reduced. Over 43 million mu of pastoral areas throughout the region have deteriorated, constituting 97 percent of the pastoral areas in the entire region. 4. Forest coverings were destroyed. The Liupan Shan formerly had 520,000 mu of woodland, which has now been reduced to 420,000 mu. The Lao Shan formerly had 180,000 mu of woodland, now reduced to a little over 100,000 mu. The Helan Shan formerly had over 2.5 million mu of woodland, now reduced to some 2.3 million mu. The Honggoutan of the Luo Shan had nearly

10,000 mu of artificial woodland in the 1960's, which have all been destroyed in the 1970's. The Liujia Sandy Hollow of the Majiatan in Lingwu formerly had over 200,000 mu of (Ning Tiao Lin), some 180,000 mu of which have been destroyed. There has been a total reduction of over 700,000 mu of woodland in the entire region. The rate of forest coverings in the entire region is only 2.3 percent. 5. Salinization of the soil is serious. Over 7.5 million mu of land throughout the region are suffering from alkalinization.

Not only have the above situations not been regarded with importance, the pollution of the agricultural environment has continued to develop. In implementing the various forms of system of responsibility in production and specialized contracting, many localities have often times paid attention solely to economic results and have neglected environmental results. In some localities, a predatory form of development and utilization of agricultural resources still exists. At a time when rural and urban enterprises are prospering, inappropriate industrial structure, irrational enterprise planning and poor pollution control facilities have also appeared in many localities, thus increasing the urgency to solve this problem.

The comrades who participated in the symposium made the following appeal: We must develop an ecological agriculture and protect the agricultural ecological environment in order to promote the development of agricultural production. The environmental protection departments at various levels must closely coordinate with the agricultural departments at various levels to commonly emphasize properly the work of protecting the agricultural ecological environment. Currently, we must especially strengthen propaganda and education and enable the broad masses of cadres and people to understand the important meaning of developing an ecological agriculture toward protecting the agricultural ecological environment and promoting agricultural and economic development. In this way, we will attach importance to this work and rationally develop and utilize our natural resources, prevent environmental pollution and destruction, and preserve a fine ecological environment in a down-to-earth manner. This is a work with a very strong comprehensive and local touch involving a broad area. The local govenmment, particularly the country and township people's government, must strengthen leadership and actively support the work of the environmental protection and agricultural departments, so as to launch well the work of protecting the agricultural production environment in our region.

Commentary on Agricultural Environment

Yinchuan NINGXIA RIBAO in Chinese 14 Dec 84 p 1

[Article by staff commentator: "Struggle for the Building of a Fine Agricultural Ecological Environment!"]

[Text] Developing an ecological agriculture and protecting the agricultural ecological environment are the important topics related to the acceleration of the modernization in agriculture, the development of agricultural productive forces, and the realization of the goal of struggle in economic construction by the end of this century. They are also important issues related to

the improvement of the domestic and living environment of the peasants. An agricultural ecological environment is the material basis for launching agricultural production. The main components of agricultural production are cultivation and breeding. These two undertakings both involve biological reproduction, and enjoy a close relationship with such basic elements in the natural environment such as water, air and soil. When the environmental factors are good, the living organisms will grow well, and will render stable and high yield. When the environmental factors are poor, the growth and development of these living organisms will be affected and reduction of output or even extinction may result. Once the agricultural ecological environment is destroyed, it will be extremely difficult or even impossible to be reversed. Once the soil is polluted, and water and soil are lost or the land is turned into desert and is salinized, treatment will be very difficult. In some areas where the agricultural ecological environment has been destroyed, not only is it impossible to carry out agricultural production, but it is impossible for mankind to survive, for the basic factors for mankind's survival have been lost. That is why we say that the protection of the agricultural ecological environment is an extremely important task.

Due to the problems left over by history and the influence of the "leftist" thinking, the agricultural ecological environment in our region, which was formerly undermined, has continued to be undermined. As a result, our forest coverings have been reduced, the quality of our pastures has been lowered, a large volume of water and soil has been lost, our desert land has been expanded, and the harm of salinization has been serious. All these have restricted the sustained development of agricultural production. In the last few years, while implementing the various forms of system of responsibility in production and specialized contracting, many areas have oftentimes paid attention only to economic results and have neglected the ecological (environmental) results. The rise of rural and urban enterprises has also brought about pollution to the rural areas. These situations have indicated that the protection of the agricultural ecological environment in our region is an extremely important and urgent task. In his speech on one occasion, Comrade Zhao Ziyang pointed out: "Now, if a problem appears in the rural areas, it most likely is not a problem involving the system of ownership, but involving the destruction of the natural environment and the ecological balance." This is in line with the present condition of the rural areas in our region. We must attach sufficient importance to the problem of changing the agricultural ecological environment, raise our understanding, carry out study conscientiously and pay attention to solving the problem, and enable our region's agricultural ecological environment to change from a vicious cycle into a benign cycle.

To protect the agricultural ecological environment, we must work hard in the following three aspects: First, we must rationally develop and utilize our natural resources. Second, we must adopt advanced and scientific agricultural production technology. Third, we must prevent the pollution of the agricultural ecological environment by the three industrial wastes.

To protect the agricultural ecological environment, we must first of all develop an ecological agriculture. We must take into consideration the natural geographical factors of different places and design a new ecological

agricultural model with high productive forces in line with local conditions in order to guide the development of agricultural production. In formulating contracting agreements, the rural areas should stipulate economic targets as well as ecological targets. They should assume economic responsibility as well as the responsibility in protecting the environment. In developing the various forms of specialized households and economic integrated bodies, we should carry out organization in accordance with the economic laws as well as the ecological laws. In setting up rural and urban industries, we must reduce the development of rural and urban industries which pollute the environment. In village and township planning and building, we should all the more give full consideration to the demand of developing an ecological agriculture so as to enable the villages and towns to develop into ecological villages and ecological towns.

We must no longer be shortsighted and commit the stupid act of harming the agricultural ecological environment and leaving trouble for our future generations. The situation of agricultural production in our region is very good. As long as we pay attention to protecting the agricultural ecological system, we will be able to develop agriculture vigorously. The government departments, especially the environmental protection departments and agricultural departments, at various levels, the broad masses of cadres, and the broad masses of peasants, must raise their understanding, wage common effort, and struggle to build a fine agricultural ecological environment!

9335
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ENVIRONMENTAL QUALITY

POLLUTION CONTROL OF HUANGPU JIANG DISCUSSED

Beijing GUANGMING RIBAO in Chinese 27 Dec 84 p 2

[Article by Gong Miaohong [7895 1181 5725]: "How To Control the Pollution of the Huangpu Jiang--A Visit With Xu Jingwen, Environmental Protection Specialist"]

[Text] In an interview with us, Xu Jingwen [6079 2529 2429], senior engineer of the Shanghai Municipal Environmental Protection Scientific Research Institute and deputy director of the Shanghai Water Purification Society, came straight to the point and said: "In controlling the pollution of the Huangpu Jiang, we have, for several years, basically remained in the stage of investigating and probing the situation without much progress. The water of the Huangpu Jiang and the Suzhou He is becoming increasingly black and foul-smelling, and the period of blackness and foul smell is getting longer and longer. In 1963, it was 20 days. In 1982, it was roughly 150 days. Every year, blackness and foul smell began earlier and earlier. In 1978, the water began to smell on 12 April. In 1981, the water began to smell on 10 February. This serious pollution has caused the water quality of the Huangpu Jiang to deteriorate, and has increased the harmful substance in the drinking water for the people of Shanghai. The medical and public health departments have reported that the ratio of cancer in Shanghai has continued to increase. If we do not adopt measures rapidly under the circumstances, and procrastinate, we will endanger our future generations."

Xu proposed that: "In controlling the mud of the Huangpu Jiang, we must persevere in the principle of unifying environmental results and economic results."

He proposed the following specific methods:

I. We Should Proceed From the Sources of Pollution, for They Are the Root.

Some people advocate that digging up the mud of the Huangpu Jiang is only a palliative measure, since new mud will appear after old mud is dug up.

II. Break Up the Whole Into Parts and Carry Out Contracting in Groups.

In order to uproot the sources of pollution, the enterprises must handle the matter themselves. The departments in charge should assist the factories in

formulating programs of control and handle the factories one by one in an organized manner. Properly controlling one factory is to have uprooted a pollution outlet. We should control several factories in a year, and popularize the effort among the trades also. In several years, we will have handled a large number of factories and a large number of trades. The method of relying solely on penalties to restrict the discharge of waste water by the factories is a passive one. No matter how high the penalties are, we will not be able to control the sources of pollution.

III. Integrate Pollution Control With Enterprise Transformation.

The investigative results prove that many of the pollutants in the waste water of most factories are resulted from improper technological management in production. Many valuable raw materials have gone into the water as wastes, thereby wasting raw materials and polluting the environment at the same time. We must closely integrate the task of uprooting the sources of pollution with enterprise rectification, enterprise production and technological management and technological reform. This is a measure that uses little money and accomplishes much work.

For instance, the paint we use for the body of an automobile is a spray paint, which is a poisonous solvent. If we use the advanced method of electrophoretic coating, we can prevent pollution by the solvent as well as economize on raw material.

IV. Build Sewage Plants To Treat Domestic Sewage.

If each district builds a sewage treatment plant with a capacity of 100,000 to 200,000 tons, then the task of sewage treatment for the entire Shanghai will be taken care of. Since there is land shortage in Shanghai, using the 10-meter "deep aeration" tank will be more suitable.

Presently, Shanghai has six sewage treatment plants, which are capable of treating only 140,000 tons of sewage. There are still 900,000 to 1,000,000 tons of untreated domestic sewage. We are in urgent need to build 10 sewage plants. If we build two to three 100,000-ton sewage plants every year, we will complete all the construction in 8 years, and will basically solve the problem of domestic sewage treatment in Shanghai.

Lastly, Xu Jingwen emphasized that, to control the pollution of Shanghai's Huangpu Jiang, the government departments must strengthen leadership and the scientific research and designing units must take the initiative to coordinate work. We should swiftly set up a Huangpu Jiang Control Headquarters under the leadership of the municipal people's government, organize the various concerned departments in charge, the factories and enterprises and the scientific research and designing units, and carry out propaganda on the system of responsibility and system of contracting between counterpart organizations. Xu Jingwen expressed his willingness to dedicate his life to and assume chief technical responsibility in controlling the Huangpu Jiang in order to bring benefit to the people.

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ENVIRONMENTAL QUALITY

SHANGHAI PLANS 12 MAJOR ANTIPOLLUTION MEASURES

OW060148 Beijing XINHUA in English 0126 GMT 6 Mar 85

[Text] Shanghai, March 6 (Xinhua) -- Shanghai, China's leading industrial city, plans 12 major anti-pollution measures this year, the municipal environmental protection bureau said here today.

Top priority will go to upgrading smoky furnaces, kilns and stoves, bureau officials said. The city has already altered 96 percent of its coal-burning furnaces in recent years.

Construction of central heating plants in the Chenjiadu district will also be speeded up, and monitors installed to check the exhaust emissions of new motor vehicles.

Further projects will move against factories discharging phenol into the upper reaches of the Huangpu river, where the municipality's biggest water works iw now under construction.

Electroplating shops will be told to adopt new technology to eliminate local contamination by cyanogen and other pollutants. Paper-making, chemical fibre, soap and chemical plants in the city will also be ordered to install waste water treatment facilities, according to the officials.

Measures will also be taken to quiet 150 enterprises which now produce 60 percent of Shanghai's industrial noise pollution. New anti-noise regulations will affect 90 percent of the ships passing through rivers in Shanghai, and a ban on auto horns will be extended to 12 major roads instead of the five covered last year.

8142
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ENVIRONMENTAL QUALITY

ENVIRONMENTAL PROBLEMS INVOLVING COAL INDUSTRY DISCUSSED

Status of Problems

Beijing ZHONGGUO HUANJING BAO in Chinese 12 Jan 85 p 3

[Article by Han Guangxi [7281 0342 3556]: "The Status, Countermeasures and Prospects of the Environmental Problems Caused by the Coal Industry"]

[Text] The growth in coal production and consumption has brought about the following general environmental problems: The environmental problem in the use of coal (primarily in burning) and the environmental problem in coal production (including excavation, processing, storage and transportation, and conversion).

With the development of coal processing and the building of power stations outside the coal pits, as well as coking, gasification and coal chemical industrial enterprises, there is a trend showing the concentration of the problem of pollution due to society's coal consumption on the mining areas. This not only will produce a serious impact on the ecological environment and the people's health, but will also obstruct the development of the coal industry itself. We must attach sufficient importance to the environmental problems involving the coal industry in order to unify the economic results and the environmental results of the coal industry and guarantee that the coal industry will develop healthily.

I. The status of the environmental problems involving our country's coal industry.

The major environmental problems involving the coal industry are as follows:

1. Surface subsidence caused by coal mining.

Ground coal excavation has caused surface subsidence and has led to changes in the building structures, the railroad and pipeline facilities, as well as the soil, river and water formations in the involved areas. The shallower the coal layer and the thicker the layer excavated, the more serious the surface destruction. Using the full roof caving method of coal excavation, the highest degree of surface subsidence is 0.8 times that of the total thickness of the excavated coal layer. In such extra-thick layer coal mining zones

as Fushun, the depth of subsidence has exceeded 10 meters. In addition to destroying the building structures and other engineering facilities, surface subsidence primarily destroys farmland and affects agricultural production.

2. The problem of land destruction by opencast mining.

Opencast coal mining takes up and destroys a large area of land and affects the ecological balance. The existing opencast mines in our country involve mostly the external earth disposal technology, which takes up much land and makes farmland restoration more difficult. The extent of destruction and loss of land by opencast mining differs according to the earth quality of different places. Generally speaking, because of poor farming conditions, opencast mining in the northwest region will bring about fewer losses to agriculture. However, because of its weak ecological environment, restoration will be very difficult once destruction takes place. The eastern regions, such as the eastern part of Nei Monggol, and Heilongjiang, Liaoning, Henan and Yunnan Provinces, are fine agricultural and pastoral regions. The ecological destruction by opencast mining is more obvious, bringing about greater and more direct losses to agriculture. However, because the earth layer is deep and rainfall is abundant, restoration is easier.

3. Pollution by the water from coal-washing.

There are 125 coal-washing plants throughout the country, with an annual water discharge of 7,000 tons. Thirty percent of the coal-washing plants have basically met the discharge criteria. However, only 20 percent of them have truly realized closed-circuit recycling. The suspended coal mud particles in the water from coal-washing have polluted the water body, stopped the riverways and affected the landscape of the water territory. Every year, the coal-washing plants throughout the country have lost nearly 1 million tons of coal mud. At the same time, the coking coal-washing plants have discharged water that contains harmful substances such as light diesel, phenol and fusel, endangering the survival of aquatic organisms.

To solve the pollution by the water from coal-washing, we must first of all strengthen production management and control the use of clear water and the discharge volume of water containing coal mud. Secondly, we must improve technology, adopt such advanced facilities as the filter press, and realize closed-circuit recycling. At the same time, we must pay attention to non-toxic chemicals and control the amount of usage.

4. Pollution by the acid water in the mines.

Generally, the water in the mines is not only harmless, but is a valuable resource. The Luan, Jiaozuo and Pingdingshan mining areas have utilized the water from the mines in irrigation and power generating, obtaining obvious economic and environmental results in solving the industrial and domestic use of water. However, some high-sulphur coal mines have acid water which corrodes the pipes of the facilities and seriously pollute the surface water body. In the south, the high-sulphur coal mining areas have created an even more prominent impact on the paddy fields.

The treatment of acid water is done primarily through adding alkaline substance for neutralization and achieving the goal of eliminating pollution.

5. Environmental pollution by coal refuse.

The discharged coal refuse constitutes roughly 20 percent of the output of raw coal. At present, our annual discharge volume is roughly 100 million tons. The whole country has a cumulative volume of 1.2 billion tons of coal refuse.

The impact of coal refuse on the environment is: First, it invades the farmland, and second, it pollutes the air through self-ignition.

To solve the pollution by coal refuse, we should primarily launch comprehensive utilization. For instance, it can be used as a construction material. We can manufacture low-heat fuel to be used in burning boiler, generating electricity, filling excavated areas and collapsed areas, and building roads. The refuse which cannot be consumed can be glattened and made firm, and the earth can be covered with grass again. As for the self-ignited refuse, we can adopt such fire extinguishing measures as grouting and application of lime water.

6. Dust and coal dust pollution.

In the process of crashing, sifting, transporting and storing of the coal mine production system as well as the coal-dressing plants, the cement factories and the brickworks, a large volume of dust is produced. The miner's lamp factories and the dynamite factories also give off a small amount of metallic TNT dust. This dust will directly affect the health of the staff members and workers as well as bring about loss of a large volume of energy. Due to unsuitable installations and facilities and improper management of railroad and waterway transportation, coal is scattered, lost and strewn all over the place. Every year, there is at least a loss of several million tons of coal.

Environmental Countermeasures

Beijing ZHONGGUO HUANJING BAO in Chinese 26 Jan 85 p 3

[Article by Han Guangxi]

[Text] II. Environmental countermeasures in the coal industry.

Our country is a socialist country. We cannot follow the footsteps of the Western countries of pollution first and control later. Also, ours is a developing nation. Our environmental countermeasures must correspond to our national strength and must take promoting our economic development as a prerequisite.

There are three outstanding characteristics in our environmental problems involving the coal industry: First, our discharge volume of the "three wastes" is great. Coal refuse alone constitutes one-fourth of the volume of industrial dross discharged throughout the country. If we add the stripped substance from opencast mining, our volume will be even greater. Second, the toxicity from pollution is, relatively speaking, lower. The "three wastes" rarely involve cyanogen, arsenic and toxic heavy metals. Third, retrieval for utilization is easy. This primarily refers to "waste water" (such as water in the coal pits and water from coal-washing) and "dross" (such as coal refuse), which can be retrieved or reused through relatively simple technological measures.

In light of these characteristics and the current technological and economic factors of our country, we should adopt different countermeasures toward difference environmental problems involving the coal industry:

1. We should primarily solve through planning such problems as the surface subsidence of coal pits and the surface destruction caused by opencast mining. The important engineering facilities such as building construction and communications should stay away from the collapsed and subsided regions in order to minimize as much loss as possible. The properly-equipped coal pits can adopt filling as a means to reduce surface subsidence. Toward those pits which have already collapsed and subsided, we can adopt the measure of combining restoration of farmland with utilization. This includes restoring farming as well as storing water for irrigation, breeding fish and cultivating aquatic products. The opencast mines should adopt the internal earth disposal technology in order to occupy less land. Certain areas of the northwest basically lack the conditions for cultivation. In opencast mining, we should pay attention primarily to protecting the existing ecological environment and see that as little damage as possible is done to it. In the eastern regions where rainfall is abundant and agriculture and animal husbandry are developed, we should emphasize the restoration of farmland in order to reduce the losses in agriculture and animal husbandry. In the pastoral regions, we must also pay attention to doing a good job of protecting the water resources and the pastures.

2. We should establish our foothold on "utilizing" the large volume of discharged "three wastes" such as coal refuse and water in the coal pits, and attain the goal of pollution prevention and treatment by means of comprehensive utilization. We should use economic policies to encourage the consumption of coal refuse and the protection of farmland. In the northern part as well as certain regions of our country, there is a serious shortage of water. In these regions, we should regard the water in the coal pits as a valuable resource, and encourage its development and utilization. We should not regard this water as one of the industrial "three wastes." When the water quality is basically harmless to the environment and actually beneficial to irrigation, we should attempt pollution discharge fees or grant other preferential treatments accordingly.

3. We should first of all establish our foothold on technological reform with regard to the pollution which can be eradicated technologically, for instance,

the closed-circuit recycling of water from coal-washing. We should adopt the measure of taking control as the key only on the pollutants which we cannot technologically eradicate and cannot directly utilize.

III. Prospects for the environmental protection of the coal mines in our country.

The surface subsidence of coal pits and the land destruction through opencast mining will inevitably increase with the doubling of coal output and the increase in the proportion of opencast mining. Through rational planning and strict capital construction procedures, we can reduce to a great extent the losses brought about by the destruction of surface facilities in the future. The collapsed and subsided pits will gradually be utilized. However, a large-scale restoration of farmland is still difficult at present. We can only establish pilots prior to the "Seventh 5-Year Plan," and can only launch the work on a large scale in the later 10 years.

The water from coal-washing will increase rapidly with the development of coal washing, dressing, and processing. However, the discharge volume will not increase conspicuously. Before 1990, with the strengthening of production management and technological transformation and the limited number of new plants going into operation, the discharge volume will even display a dropping trend. It is estimated that most of the existing factories in operation can meet the discharge criteria, and that half of the factories have realized closed-circuit recycling.

The water discharged from the coal pits will inevitably increase, but will not double before the end of this century. This is because the existing mines in operation (the state-monopolized coal mines) are already discharging water from the coal pits. In the next 18 years, not too many new pits will be built. The local mines will increase more output, but they will mostly excavate coal from the shallow layers, involving a small volume of water discharge. Most of the newly-built opencast mines are located in the dry regions. Because the technology involving the control of water in the coal pits is not a complex one, the problem of pollution will basically be solved in the "Seventh 5-Year Plan" period.

The discharged volume of coal refuse will increase by a wide margin with the deepening of the mines, the improvement in mechanization, the increase in output, as well as the development of washing, dressing and processing. It is estimated that, by the end of this century, the discharged volume can exceed 250 million tons. With the increase in the retrieval capability of coal and ferrous sulphate and the progress in the related scientific research work, we can anticipate a technological solution basically to the problem of eradciating the self-ignition of coal refuse by the "Seventh 5-Year Plan" period. Again, the large-scale restoration of soil for the building of farmland and trees will primarily be an event in the later 10 years.

Such new technologies as the on-site conversion of a large amount of coal into electric energy and the use of long-distance transportation of coal by

pipelines will have a decisive significance on the pollution by coal dust in the process of coal transportation.

In short, through strengthening management and technological transformation, and through the strict control of the new sources of pollution, we can solve the environmental problems involving the coal industry step by step, and basically change the environmental outlook of the mining areas.

9335
CSO: 4008/226

ENVIRONMENTAL QUALITY

HENAN PROVINCE DOES WELL IN AFFORESTATION

HK131558 Zhengzhou Henan Provincial Service in Mandarin 2300 GMT 11 Mar 85

[Excerpts] HENAN RIBAO today carried two items on its front page about the province's afforestation.

One item is on the bright prospects for developing fast growing and high yield forests in the province. Over the past 3 years the province has planted 200,000 mu of fast growing and high yield forests with state subsidies and funds raised by the masses. Planting forests by peasants with funds raised by them has become the main system used.

The other item is on relaxing policies on forestry and giving full play to natural superiorities. The province has developed some 6 million mu of economic forests.

HENAN RIBAO also published a commentator's article entitled: Maintaining the Good Trend in Afforestation. The article pointed out that the province has achieved remarkable results in afforestation over the past year.

If we maintain this good trend, then the undertaking of greening Henan will be promising.

The province has made great achievements in afforestation over the past few years, but the development has been uneven on the whole. There are still some 20 million mu of barren mountainous land on which trees have not yet been planted, and we have failed to make full use of the land around villages and houses and along rivers and roads to plant trees. Much needs to be done in readjusting the forestry structure, in preventing and curing forest diseases and insects, and in processing and utilizing sideline products of forestry. Even those places where forests have been properly planted to protect farmland on plains are also facing the problem of consolidating the achievements in afforestation.

The key to maintaining the good trend in afforestation lies in proper and effective implementation of the policy of the CPC Central Committee and the State Council toward forestry. While readjusting the production structure and vigorously developing agriculture, industry, and sideline production, we must by no means neglect forestry, which is a long-term undertaking.

It is now the best season to plant trees, and the people throughout the province must take this good opportunity to make continuous efforts and present a newer and more beautiful picture of Henan by planting trees with our untiring hands.

7473
CSO: 4008/266

ENVIRONMENTAL QUALITY

GUANGXI HOLDS TELEPHONE CONFERENCE ON AFFORESTATION

HK130306 Nanning Guangxi Regional Service in Mandarin 1130 GMT 11 Mar 85

[Excerpts] Yesterday evening the Regional Greening Committee held a telephone conference, demanding that all localities take effective measures to launch a tree-planting drive before doing spring farmwork and strive to fulfill and overfulfill this year's afforestation task for the region within a short time.

The telephone conference was presided over by Comrade Zhang Shengzhen, Standing Committee member of the Regional CPC Committee and vice chairman of the regional people's government and vice chairman of the Regional Greening Committee.

Comrade Wei Chunshu, deputy secretary of the Regional CPC Committee and chairman of the regional people's government and chairman of the Regional Greening Committee, delivered a speech at the conference.

He said: Since the issuing of Document No. 1 of the CPC Central Committee for this year, there has been a rapid development in forestry production. In accordance with the spirit of the central document, the region has decided to abolish monopolized purchase of timber in collective forest zones, to carry out a pilot project of planned felling, to establish timber markets, and to give permission to forestry farmers and collectives to sell their timber in free markets at negotiated prices. [passage omitted]

By 5 March, the region had carried out artificial afforestation on 1.05 million mu of land, raised seedlings on 10,100 mu of land, and planted trees on 1.35 million mu of land by airplane seeding. [passage omitted]

In order to fulfill and overfulfill this year's afforestation target for the region within a short time, Comrade Wei Chunshu put forth three suggestions:

1. It is necessary to firmly grasp ideological mobilization. [passage omitted]

2. It is necessary to implement specific measures. [passage omitted]

3. It is necessary to effectively strengthen the leadership over afforestation. [passage omitted]

Attending the conference were members of the reorganized Regional Greening Committee and responsible comrades of the regional departments concerned.

7374
CSO: 4008/266

ENVIRONMENTAL QUALITY

LIAONING AFFORESTATION COMMITTEE HOLDS SESSION

SK110336 Shenyang Liaoning Provincial Service in Mandarin 1030 GMT 10 Mar 85

[Excerpt] At today's fourth enlarged plenary session of the provincial afforestation committee, Sun Qi, vice chairman of the provincial afforestation committee and vice governor, stressed that we should attend to practical results in a down-to-earth manner, prevent making a terrific din, and not pay lip service or practice formalism in order to promote our province's campaign for making the motherland green to a new level.

Comrade Sun Qi made a speech on how to achieve the province's afforestation work in 1985.

He said: Planting trees and growing grasses to make the motherland green is the primary work to promote a virtuous circle of the natural ecosystem, is related to the important strategic issue of realizing the target for quadrupling the total annual industrial and agricultural output value by the end of this century, and is a matter of fundamental importance for accelerating socialist modernization. We should mobilize the people across the province to persistently and continuously promote the great undertaking of bringing benefits to future generations.

Comrade Sun Qi said: This year, we should conscientiously strengthen the leadership over afforestation work and accelerate the pace of afforestation work in line with different local conditions. Simultaneously, we should further emancipate our minds, relax policy restrictions, set up and perfect various forms of the forestry production responsibility systems, and adopt proper policies to arouse the enthusiasm of the cadres and people to engage in afforestation and to grow grasses and flowers.

The session pointed out: This year, the province plans to voluntarily plant 84 million trees. This is calculated in terms of having each person of the right age plant four trees. The province plants to afforest 3 million mu, to plant 100 million trees around houses and along rivers, roads, and ditches, and to grow 330,000 mu of saplings. [passage omitted]

0597
CSO: 4008/266

ENVIRONMENTAL QUALITY

HEILONGJIANG HOLDS AFFORESTATION COMMENDATION RALLY

SK130420 Harbin Heilongjiang Provincial Service in Mandarin 1000 GMT 12 Mar 85

[Text] This morning, the provincial greening committee held a provincial commendation and mobilization rally, which was broadcast by radio, on afforestation, forest protection, and fire prevention. Governor Chen Lei spoke at the rally.

Today is Arbor Day in China. Last year, our province vigorously reformed the forestry system, eased the restrictions on the forestry operational system, actively carried out afforestation together with the state, collectives, and individuals, and scored great achievements. The afforested area reached 7.9 million mu and the average survival rate of trees reached 86.7 percent. Some 80 million trees were planted voluntarily. All three targets topped the highest level in history.

The provincial greening committee set forth afforestation tasks at today's rally: This year, the province as a whole will afforest 5 million mu and cultivate 650,000 mu of saplings. According to the requirements prescribed by law, each person should voluntarily plant an average of 3 to 5 trees. The rally stressed: We should focus our work on reform and rapidly ease the forestry policy restrictions, actively help the key and specialized households become prosperous, and encourage the masses to invest money and labor in making the barren hills and wastelands green. All localities should work in accordance with the afforestation responsibility pledges which they made last year, persist in the principle of combining management with protection in cultivating saplings and afforestation, and attach importance to both afforestation and management and to ensuring the survival of forests and the realization of fast growth and high-yield forests. From now on, all localities should go into action, make all necessary preparations, and ensure that spring afforestation activities and spring fire prevention work will be carried out successfully, in a timely manner.

The Central Greening Committee sent a congratulatory message to the rally.

0798
CSO: 4008/266

ENVIRONMENTAL QUALITY

STATUS, PRIMARY TASKS OF ECOTOXICOLOGY OUTLINED

Beijing HUANJING KEXUE [JOURNAL OF ENVIRONMENTAL SCIENCE] in Chinese No 6, 30 Dec 84 pp 69-70

[Excerpt] Integrate the Reality of the Four Modernization Construction Establish and Develop Our Nation's Ecotoxicology

Since China's full-scale launching of the study of environmental science in the early 70's, ecologists have engaged in discussions of environmental quality assessment, biological monitoring, and other subjects, and have carried out research on many aspects of pollution ecology. Toxicologists have done more work on the toxicological study of the level of single species, including aspects of environmental quality standard formulation, toxicity assessment of industrial wastes, heavy metals, insecticides, etc. In recent years, some research units have started studying ecotoxicology. For example, the Institute of Oceanography (CAS) has studied the toxicity of petroleum, mercury, and cadmium on the phytoplankton of the natural mixed population of Bohai Bay. They have analyzed changes of various kinds and numbers of phytoplankton, compared sensitivity, and probed the effects of the toxins on the their growth and reproduction. The Beijing municipal environmental protection institute has used simulations to study the effects of two kinds of phosphorus rock tailings on the community of large benthic invertebrates and the communities of epiphytic and floating algae. The Biology Department of Yunnan University has studied the effects of lead on the reproduction of paramecium in a single species population, using as indicators the increase of the paramecium colony, the ratio of reproduction rates among various populations, and the average life span of each generation of the population. All these show that in our country ecotoxicology has started to gain attention. But in general, as abroad in the mid-70's, ecologists and toxicologists in our country have not yet well combined to find a mutual focus to work with, or if some foci were found, they have not been carried out owing to limited methods and conditions. For example, a powerful tool in the study of ecotoxicology-the concept of world as a microcosm-has until now not been established. Therefore, in regard to the development of the discipline, the general situation is weak, but there is a certain foundation, and the key is on integration. Once ecology closely combines with toxicology and has a certain kind of support, founded on the work of the past ten years, there is hope to develop fast and show its effects. However, this kind of integration, besides the influence of the development of ecotoxicology outside of China on the environmental science of China in the past and in the future, requires also a certain social power, and specifically, the following three:

1. Include it in research on current environmental forecasting.

At present, environmental forecasting has caught the attention of the leadership departments of environmental protection at various levels in China. In research on forecasting, we must pay attention to the various possible effects created by the growth, both in quality and quantity, of the pollutants (especially the new pollutants) in the environment due to economic development now and later on, on people and the ecological environment, and have them defined and quantified. In so doing, the ecologists and toxicologists will be attracted to the problem of environmental forecasting, where they can find many points for integration.

2. Legislation on safety assessment for new chemical products in China should be passed quickly.

From now on, it is imperative to formulate and carry out regulations on safety assessment for new chemical products. They must have some requirements about ecotoxicology. Otherwise, if they are not based on the protection of the ecosystem or the maintenance of ecological balance, or if the theories, methods or data offered are not from the view of ecotoxicology, these regulations will not be effectively carried out.

3. Actively join in the formulation and revision of environmental quality standards.

Environmental quality standards are the basis of environmental management. All perfect environmental quality standards should be able to protect the structure and function of the natural ecosystem, and maintain the ecological balance. However, at present the current environmental quality standards within and without the country still cannot guarantee this point. The key lies in that, during environmental quality standard revision, we should establish, step by step, an ecotoxicological indexing system for our country. China has a vast territory and the differences between the natural ecosystems of various places are great; it is difficult to use just one standard for all regions. In formulation of regional ecological quality standards in various districts, we must suit local conditions, integrate the characteristics of the local ecological system, and provide full consideration to the environment which can cause changes both in the pollutant and the living organism. In this aspect, the tasks in ecotoxicology are heavy and difficult.

12909
CSO: 4008/189

BRIEFS

TAIYUAN FOREST PARK--Taiyuan, February 27 (XINHUA)--The industrial city of Taiyuan is building a 300-hectare forest park, planning official Fan Shoude told XINHUA today. It is on the Fenhe River, which bisects Taiyuan, the capital of Shanxi Province. The unfenced park will have a hunting ground with villas and hotels in various styles plus riding and picnic facilities. It will quintuple the city's park area. This is part of the city's effort to improve the urban environment, which used to be seriously polluted. A big tree and grass planting drive has been launched over the past few years. Now the urban areas covered with green reached 3,570 hectares, about 25 percent of the total area. Plans have been made to green another 74,000 hectares by the end of this century, Fan said. [Text] [Beijing XINHUA in English 0818 GMT 27 Feb 85 OW] 1875

CHANGSHA SEWAGE PLANT--A sewage plant which can treat 60,000 tons daily has started operation in Changsha, capital of Hunan Province. The city used to pipe untreated waste directly into the Xiangjiang River which winds around the city. HUNAN DAILY reports. [Text] [Beijing CHINA DAILY in English 6 Mar 85 p 3] 6855

JILIN AFFORESTATION--Huo Mingguang, vice governor of Jilin Province and chairman of the provincial greening committee, told a reporter on 11 March that Jilin Province afforested 4,509,000 mu in 1984, surpassing the annual plan by 180 percent, and voluntarily planted 116,360,000 trees, surpassing the annual plan by 191 percent. Nine cities planted a total of 8 million trees, 1.75 million square meters of potted flowers, and 180,000 square meters of lawn, a record in the province. Huo Mingguang told the reporter that in 1985, Jilin Province plans to afforest 3.45 million mu and voluntarily plant 54.47 million trees. [Summary] [Changchun Jilin Provincial Service in Mandarin 1030 GMT 11 Mar 85]

LIAONING AFFORESTATION--In 1984, Liaoning Province had 14.847 million people participating in voluntary tree planting, planting 135.8 million trees, a 61.7 percent increase over the quota. It completed 2,235 key afforestation projects, afforesting 295,000 mu of land. Normal afforestation was accelerated. The province afforested 4.12 million mu last year, exceeding the quota by 37.5 percent. Tree planting quality was also improved remarkably. Tree survival rate in spring afforestation was 76.9 percent, 5 percent more than in the same period of 1983. By the end of 1984, the province had allocated 16 million mu of private hills and 9.57 million mu of contracted hills to 2.03 million peasant households. The private hills and contracted hills amounted to 65.9 percent of the province's afforested area. Specialized tree planting households in the province increased from 130,000 to 270,000. [Summary] [Shenyang Liaoning Provincial Service in Mandarin 1030 GMT 11 Mar 85 SK]

Marine Science

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TITLE: "The Calculation of Space-Time Correlation Function of Noise Field of Surface Noise Source With Dipole Radiation Model"

SOURCE: Beijing HAIYANG KEXUE [JOURNAL OF MARINE SCIENCE] in Chinese No 6, 9 Nov 84 pp 39-41

ABSTRACT: Due to the fact that all sources of noise on the ocean surface may be abstractly expressed as dipole radiation sources, a study on the space-time correlation function of the noise field of ocean surface has practical significance. For the study, dipole radiation sources were evenly and independently distributed on the surface of sea water, with $S(\omega)$ as the radiation spectrum. The method of calculation presented in the paper is different from that of Roberson, R (JASA Vol 23 No 3, 1951 pp 353-359), but the result is the same.

6248
CSO: 4009/130

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ORG: LI, YU of Research Institute of Oceanography, Chinese Academy of Sciences; GU of Research Institute of Nuclear Energy, Chinese Academy of Sciences

TITLE: "Determination of the Concentration of Plutonium in Sediments of Bohai Bay"

SOURCE: Beijing HAIYANG KEXUE [JOURNAL OF MARINE SCIENCE] in Chinese No 6, 9 Nov 84 pp 19-22

ABSTRACT: In the first half of 1981, top layer sediments in 19 stations in Bohai Bay were gathered to proceed with analysis, isolation, and determination of their plutonium content. Results indicate that the Pu content of the sediments of the various stations fluctuates at $(2.5\text{-}7.6) \times 10^{-15}$ x Ci/g, i.e. between 2.5-7.5 fCi/g, with an average of 5.5×10^{-15} Ci/g, i.e. 5.5 fCi/g. The project includes the determination of $^{239}Pu+^{240}Pu+^{238}Pu$, and ^{241}Pu but due to the limited condition of the laboratory, these isotopes were not isolated for separate determination. A map is included to show the locations of the sampled stations and the Pu density of the sediments obtained from each station. The results are compared with reports of other countries of the world. The relationship between Pu distribution and the grain size of the sediments, the transfer and dispersion of Pu in the marine environment, and the ratio of Pu and Cs are discussed in some detail.

6248
CSO: 4009/130

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TITLE: "Self-Sustaining Organisms of Chemical Energy in the Deep Sea"

SOURCE: Beijing HAIYANG KEXUE [JOURNAL OF MARINE SCIENCE] in Chinese No 6, 9 Nov 84 pp 53-57

ABSTRACT: On the primordial earth, oxygen was deficient. Using H_2S as the electron source, prokaryotes were the earliest photo-energy self-sustaining organisms. Later, blue and green algae evolved as eukaryotes, using H_2O as the electron source and their synthesis by-product became oxygen, instead of sulfur in case of the prokaryotes. In the evolution process, chemical energy self-sustaining organisms should be regarded as coming after green plants of photo-synthesis. In the deep sea, 2,000 m below the surface, photo energy self-sustaining organisms have no way of surviving in such darkness; therefore, the deep sea had been considered a region without life. In recent years, marine scientists of the USA discovered some vents on the ocean floor at a depth of 2,500 m. Benthic animals and organisms were found to grow densely around these vents. Discoveries of Woods, Hole, Scripps, et al in Galapagos of South America and the animal species they found are described and discussed in the paper.

6248
CSO: 4009/130

JPRS-CST-85-009
9 April 1985

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TITLE: "Study on the High Efficacy Induction of Human IFN-ν and Characterization of Its mRNA"

SOURCE: Beijing ZHONGHUA WEISHENGWUXUE HE MIANYIXUE ZAZHI [CHINESE JOURNAL OF MICROBIOLOGY AND IMMUNOLOGY] in Chinese No 6, Dec 84 pp 339-342

TEXT OF ENGLISH ABSTRACT: A study on the effects of different mitogens on the induction of IFN-ν was carried out in a human leukocytes culture. Results showed that a high titer of IFN-ν was induced by TPA/PHA combined with tuberculin (Tub). The average titer reached about 10^4 units/ml. The TPA/PHA/Tub induced interferon was unstable at pH2 and 56°C for 3 hours. Anti-IFN-α or β sera could not neutralize its antiviral activity.

Results obtained by using Xenopus laevis oocytes (XLO) as a translation system showed that the kinetics of synthesis of IFN-ν-mRNA were different from those of IFN-α or β. It appears to be synthesized 9 hours after induction, raised to its highest level at 24 hours and declines after 36 hours as compared with IFN production in the same culture, which reached its maximum at 36 hours after induction, indicating a 12-hour lag after the mRNA peak.

Results obtained by determining the antiviral activity of translation products in XLO microinjected with different fractions of poly(A)RNA after 5-20 percent sucrose gradient centrifugation indicate that IFN-ν-mRNA appeared in 16 S fraction.

9717
CSO: 4009/128

Oceanography

AUTHOR: LIANG Yuanbo [2733 0337 0590]
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TITLE: "Mechanism of Effects of the Mechancal Properties of Ocean Floor Sediments on the Velocity of Sound Propagation"

SOURCE: Beijing HAIYANG XUEBAO [ACTA OCEANOLOGICA SINICA] in Chinese No 1, 15 Jan 85 pp 111-119

ABSTRACT: Experimental results and theoretical analyses indicate that when sound passes a fluid saturated and porous medium such as sediments of the ocean floor, the speed of propagation is influenced by the solid portion of the medium and the fluid portion in the pores. The concept of Biot, Wyllie, etc. and the related Anderson equation commonly applied in petroleum geology and sound wave prospecting in the past 2 decades are discussed. Aside from porosity, there has not been satisfactory interpretation of other influential parameters such as flow, plasticity, elasticity, specific gravity, grain size, etc. The paper suggests the introduction of the mechanical factor γ_y, to become the third parameter in the experimental equation of Anderson. With this added parameter, the computation is more precise and the necessity of statistical measurement of micropores is avoided.

6248
CSO: 4009/125

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TITLE: "Linear Surge of Homogeneous Fluid in Isobathic Rotation: I"

SOURCE: Beijing HAIYANG XUEBAO [ACTA OCEANOLOGICA SINICA] in Chinese No 1, 15 Jan 85 pp 1-11

ABSTRACT: Without assuming the absence of rotation and static pressure distribution, this paper introduces a linear surge equation of an ideal noncompressible homogeneous fluid suitable for application to ocean floors of any topography. Using this equation, a unified solution is obtained for an existing surge of a marine region of constant depth. The common approach of using assumptions of an absence of rotation and static pressure is also discussed in the paper.

This paper was received for publication on 23 Jan 84.

6248
CSO: 4009/125

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TITLE: "A Study on the Use of Mussels as Biological Indicator of Co Pollution of the Sea"

SOURCE: Beijing HAIYANG XUEBAO [ACTA OCEANOLOGICA SINICA] in Chinese No 1, 15 Jan 85 pp 120-128

ABSTRACT: Mussels of the species of Mytilus viridis Linnaeus were cultured in seawater of different ^{60}Co, ^{137}Cs densities for 1 month before analyzing the accumulation of monocuclear ^{60}Co or ^{137}Cs and the binuclear ^{60}Co + ^{137}Cs in the various tissues and organs of the mussel and determining the linear relationship between the accumulation and the different densities of the seawater. Afterwards, a 1-month experiment was also carried out to study the elements expelled by the mussels. Results of the study indicate that tissues of this species can accumulate very high levels of ^{60}Co and expell it in a very slow rate. There is a definite linear relationship between the accumulated quantity in the mussel and the density of the seawater, but no linear relationship between the quantity expelled and the density. The authors conclude that this species of mussels can be used as the indicator of pollution of marine regions.

6248
CSO: 4009/125

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ORG: All of the Department of Physics

TITLE: "Studies on Solvent Effects of Several New Laser Dyes with Time-resolved Spectral Techniques"

SOURCE: Guangzhou ZHONGSHAN DAXUE XUEBAO (ZIRAN KEXUE BAN) [ACTA SCIENTIARUM NATURALIUM UNIVERSITATIS SUNYATSEN] in Chinese No 4, Nov 84 pp 55-61

TEXT OF ENGLISH ABSTRACT: The spectral, lasing properties and solvent effects of several new laser dyes in the ultraviolet region have been investigated. Their absorption spectra, fluorescence spectra and kinetics fluorescence in various organic solvents are reported. The spectral properties, luminescence efficiency and laser energy conversion ratio influenced by solvents have also been investigated. These new dyes have high laser energy conversion efficiency and good chemical stability in a suitable mixture of the solvent.

9717
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9 April 1985

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TITLE: "Investigation of Some Properties of SQS Drift Chamber"

SOURCE: Beijing GAONENG WULI YU HE WULI [PHYSICA ENERGIAE FORTIS ET PHYSICA NUCLEARIS] in Chinese Vol 8 No 6, Nov 84 pp 657-663

TEXT OF ENGLISH ABSTRACT: Some performances of an adjustable field drift chamber operating in the self-quenching streamer mode (sQs) have been measured. The counting rate plateaus as a function of threshold and gas mixture, the efficiency, the sQs pulse amplitude, the relationship between drift distance and drift-time, the pulse heights in different drift distances and the transition characteristics from saturated avalanche to sQs-discharge mode are presented in this paper. The influences of the benzene vapor are also studied.

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et al.

ORG: All of the Institute of High Energy Physics, Chinese Academy of Sciences

TITLE: "Measurement of Cross Section of High Energy Iron Nucleus ($E \geq 4$GeV/N)-Aluminum Nucleus Interactions"

SOURCE: Beijing GAONENG WULI YU HE WULI [PHYSICA ENERGIAE FORTIS ET PHYSICA NUCLEARIS] in Chinese Vol 8 No 6, Nov 84 pp 664-667

TEXT OF ENGLISH ABSTRACT: For the purpose of nucleus-nucleus interaction detection, a detector consisting of CR-39 plastic track detector sheets interlayered with aluminum plates was launched to 37 km by balloon near Beijing and exposed to the high energy nucleus beam of primary cosmic rays for 10 hours. The Fe-Al interaction cross section obtained ($\Delta z \geq 1$) at the energy region higher than 4GeV/N is 1.76 ± 0.18 b.

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ORG: All of Fudan University

TITLE: "The Higher Order Quantum Corrections in Spin-Flip Synchrotron Radiation"

SOURCE: Beijing GAONENG WULI YU HE WULI [PHYSICA ENERGIAE FORTIS ET PHYSICA NUCLEARIS] in Chinese Vol 8 No 6, Nov 84 pp 688-698

TEXT OF ENGLISH ABSTRACT: The effect of synchrotron radiation on the transversal polarization of electrons is investigated. The higher order quantum corrections on spin-flip radiation probability due to photon recoil are derived by two approaches. The results reveal a decrease in final polarization and an increase in relaxation time.

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TITLE: "The Microscopic Description of $^3He(\pi^-,n)^2H$ Reaction at 100-300 MeV"

SOURCE: Beijing GAONENG WULI YU HE WULI [PHYSICA ENERGIAE FORTIS ET PHYSICA NUCLEARIS] in Chinese Vol 8 No 6, Nov 84 pp 699-706

TEXT OF ENGLISH ABSTRACT: The Isobar model of G.E. Brown, et al., for π-nucleus scattering is extended to describe the (π,N) reactions at intermediate energies. The many-body effects are treated by using a phenomenological approximation. The influences of some factors upon the differential reaction cross sections are investigated. These include nonstatic correction, nucleon correlation wave function and distorted effect of the outgoing nucleon. The angular distributions of the $^3He(\pi^-,n)^2H$ reaction at 100-300 MeV are calculated. The theoretical calculations are essentially consistent with the results of experiments.

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